PUBLIC WORKS

An Engineering and Construction Monthly

310 EAST 45TH ST. NEW YORK, N. Y.

CITY COUNTY STATE

Vol. 61 March, 1930 No. 3

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Authors and Articles in This Issue

So many men of real ability have contributed to this issue of Public Works that, despite the use of smaller type, we can not find the space for adequate discussion of them. More than nine hundred city engineers have had a share in furnishing the data for this issue. The material from which our editor, A. Prescott Folwell, compiled the forecast for *1930 Public Works Expenditures*—which we believe to be one of the most timely and valuable articles—could not have been secured except through the intelligent and whole-hearted assistance of so many of our readers.

In the highway and paving field, *F. P. Smith*, well-known consulting highway engineer of New York City; *R. A. Hamilton*, of Binghamton, Assistant Engineer of the New York State Bureau of Highways; *S. B. Shepard*, Chief Highway Engineer of St. Louis County, Minn., with offices at Duluth; *J. J. Idzorek*, County Engineer and Superintendent of Redwood County, Minn., of which Redwood Falls is the county seat; *W. A. Stacey*, of Hutchinson, Kans., county engineer of Reno County, who also had an article in our February issue; and *E. B. Johnson*, of Louisiana, are the principal contributors.

Their articles range over a rather wide field. *Mr. Smith* tells of recent developments in asphalt paving, and these have been many and important during the past year. *Mr. Hamilton* describes an interesting job that required investigation and original planning. The articles on "Frost Boils" by *Mr. Shepard;* on "Creosoted Bridges" by *Mr. Stacey*, and on "Man and Teams vs. Power Equipment" by *Mr. Idzorek* are worth study and contemplation by every highway engineer.

Sanitary engineers will find the latest dope on methods of mosquito control in the article by *Henry Johnson*, an engineer of the U. S. Public Health Service (and a brother of E. B. Johnson noted above). Hand methods of spreading oil and paris green cost too much today; machine methods are being substituted. *G. M. Ridenour*, of the New Jersey Agricultural Experiment Station, contributes a most timely and valuable article on correcting corrosive water conditions. *John J. Reid* is Commissioner of Public Works of Detroit, Mich.; his description of methods used in Detroit's daily housekeeping problem should help others to solve similar problems.

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PUBLIC WORKS is devoted to the design, construction, maintenance and operation of *public improvements.*

The major subjects covered are: Highways, Water Supply, Sewerage, Refuse Collection and Disposal, Street Cleaning, Bridges, etc.

Every progressive step is accurately and faithfully recorded.

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AN ENGINEERING AND CONSTRUCTION MONTHLY

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Recent Developments in Asphalt Paving

As used for city streets. Cold-laid asphalt. Foundations. Thickness. Plant and methods of manufacture, construction and maintenance

By Francis P. Smith, Ph. B.*

One of the most interesting developments in asphalt paving for cities is the introduction of two new types of cold-laid mixtures which differ materially from those previously employed.

For a number of years cold-laid pavements of the "Amiesite" type have been used in many of the smaller cities. This same type of mixture has also been used extensively in repair work. In making the Amiesite mixture, which may be classed as an open type asphaltic concrete with a relatively large sized aggregate, cold or slightly heated stone is first treated with a light petroleum oil (gasoline or kerosene) and is then mixed with a soft asphalt cement, usually from 80 to 110 penetration.

Quite recently, two other types of cold laid asphalt pavements have been developed known as "Macasphalt" and "Colprovia," in both of which the mineral aggregate used is smaller than that found in "Amiesite" and in which the type of mixture closely approaches a dense asphaltic concrete rather than an open one.

In "Macasphalt," an asphalt cement of approximately 200 penetration is used, composed of a pulverized hard Cuban asphalt which has been incorporated with a relatively light flux at a temperature below 250°F. The mineral aggregate is dried by means of heat and mixed with the asphalt cement in about the same proportions as a hot mixture. When the mineral aggregate is quite fine, or the mixture is not to be laid for some time, a small quantity of water is added during the mixing operation to facilitate handling by "fluffing" up the mixture.

Furrowed Surfaces Left by Rakes in Mechanical Screed Which Greatly Reduces Shoving in Front of the Roller During Compression

In "Colprovia," the mineral aggregate is usually dried at a low heat, after which it is mixed with a liquid flux, which may be heated if necessary to facilitate the coating of the aggregate. The requisite amount of powdered hard asphalt is then introduced into the mixer and mixing continued until the mixture is homogeneous. The hard asphalt and flux must be

*Member American Society of Civil Engineers; Member American Institute of Chemical Engineers.

of such a character that they will slowly combine in the cold to form a suitable asphalt cement whose consistency is regulated by the relative proportions of the two ingredients.

All of these three types of mixtures are laid cold and may be thrown open to traffic as soon as rolling is completed. The technique of laying them is practically the same as with hot mixtures, except that fire wagons may be dispensed with.

From a theoretical standpoint, the last named mixture is especially interesting. When first mixed, the aggregate is bonded together only by the light flux oil and it is not until the lapse of an appreciable amount of time, that the hard asphalt and flux combine to form a cementing medium approaching in consistency that used in hot mixtures. During the interim, the mixture would seem to be at the mercy of the traffic, but in service it performs satisfactorily and exhibits a surprising amount of stability. In view of this, it appears quite possible that we may have to revise some of our present opinions as to the amount and kind of stability required in bituminous pavements carrying modern concentrated traffic.

Service records of the two new types mentioned have been very satisfactory but, as compared with hot mixtures, they must be regarded as still somewhat in the experimental stage where heavy traffic is concerned. Their usefulness for maintenance and repair work and for pavements carrying moderate traffic, may be regarded as having been established.

As ancient history, prior to 1900, two types of cold laid pavements are perhaps interesting.

French rock asphalt as imported into this country was a fine brownish powder with practically no coherence when cold. In a few cases, chiefly owing to construction emergencies, this powder was spread while cold to a depth of two inches on a prepared foundation and lightly rolled, which left it in a very loose, fluffy state. It was then opened up to traffic, which was almost entirely horse drawn, which resulted in a surprisingly good pavement and gave satisfactory service for many years.

Natural bituminous sands and rocks have also been used occasionally in the cold state. The main street of Santa Barbara, California, was paved with bituminous sand from the deposit on the Santa Barbara Channel at Carpinteria. This was a poorly graded sand containing up to 15 per cent of a very soft bitumen and was also used as a source of refined asphalt. In this case the sand was spread and rolled cold and, except for the fact that the pavement became very soft in summer, it gave very satisfactory service under the conditions existing some thirty years ago.

RESEARCH

In the case of hot mixtures, much study is being given to the development of a type which will not be displaced by heavy traffic. Extremely dense and stable mixtures are being tried out extensively. These mixtures are much more difficult to compress than the heretofore usual type, and unless adequate compression is secured, their inherent stability is not developed and their lower bitumen content makes them susceptible to water action and cracking. It is also more difficult to secure with them a satisfactory contour of the finished pavement. Too close an approach to rigidity in asphalt pavements may be regarded as undesirable, as it involves sacrifice of the valuable qualities of malleability and shock-absorbing power and increases the noise from the passage of traffic.

Increasing attention is being paid to uniformity in the mixture, as it is obvious that a soft area bounded by a hard area is an ideal condition for producing wave formation. Experiments in the selection and grading of the mineral aggregate and a study of both solid and liquid adsorption are also being actively carried on and these give promise of developing new and important principles of design.

FOUNDATIONS

Portland cement concrete is still the preferred foundation for most of our heavily travelled city streets with a normal sub-soil. While, in a few cases, a thickness of 10 inches has been used, the average thickness is six (6) inches. Where the sub-soil is of satisfactory character and well drained, this has proved ample for almost all heavy traffic conditions. Much attention is, however, being given to the improvement of the sub-grade and its proper drainage, and to the proper backfilling of trenches, as this has proved to be better general practice than an unlimited increase in the thickness of the concrete.

An increasing amount of "Black Base" or coarse asphaltic concrete is also being used as a foundation. Where the support given by the sub-soil is adequate, this type presents many advantages. It is not subject to the expansion and contraction cracks which almost always develop to a greater or less extent in Portland cement concrete, and no time is lost in waiting for it to set, and cuts in it may be repaired easily. It is usually laid 5 or 6 inches in thickness and compressed in two layers.

THICKNESS OF PAVEMENT

For heavy-traffic sheet asphalt pavements, a binder course 1½ inches thick and a surface course of the same thickness has become pretty well standardized, replacing the old two-inch surface course over a one-inch binder. A one-inch surface course on a 1½-inch binder also has proved acceptable in some light-traffic residential districts but is difficult to lay in cold, windy weather as it chills quickly and is then liable to produce a honey-combed surface. The reduction in cost, while appreciable, is not very great. In a few cases, this type of construction has been tried out on heavy traffic streets with fairly good results.

With the finer types of asphaltic concrete, the binder course is usually omitted and the pavement laid two inches thick. The shock-absorbing power of such a pavement is, however, markedly less than that of the three-inch type first mentioned.

PLANT AND METHODS OF MANUFACTURE

There have been few radical changes in plant design. For the larger cities, the permanent type of plant is used almost exclusively. They have materially increased in size and the raw materials are handled with cranes, fixed or travelling, conveyors and tractor pushers. Automatic devices for weighing and measuring materials have not been employed to any extent but in the future will undoubtedly be used. It is very rare indeed to find any cases where hard asphalt and flux are mixed at the plant, as in former times. The asphalt cement of the proper penetration is purchased direct from the refiner and, wherever possible, deliveries are made in tank cars. The use of pyrometers to record and control heat has become well nigh universal.

CONSTRUCTION METHODS AND EQUIPMENT

Improved street equipment is being devised to take care of the increased output from the large plants and to reduce cost. For asphaltic concrete and binder mixtures, spreader boxes are in general use. These are either attached to the rear of the truck which delivers the mixture to the street, the mixture being spread while the truck is in motion, or they are sufficiently large to take an entire truck load and, after being filled with the mixture, are pulled along the street by means of a roller or tractor. The depth to which the loose mixture is spread may be regulated by suitable means. By the use of either of these devices, raking is almost eliminated and a much greater quantity can be handled in a given time. By the old methods of hand shovelling and raking, the output of a large plant could not be handled properly except on very wide streets.

Spreader Box Operated by Tractor

The increasing severity of the requirements as to contour of the finished pavement and the scarcity of really good rakers has led to the development of mechanical screeds and the results obtained with them have been extremely satisfactory. A much better contour is obtained and it is possible to lay a greater yardage with them. Their use has been more extensive on country highways than on city streets, but in a number of instances they are being successfully used in cities. The numerous manholes and varying width of streets make their use more difficult and perhaps less economical in cities than on large country highway projects of fixed width.

The use of motor-driven rollers is increasing. When first introduced, clutch trouble was frequent, with resulting poor contour. Clutches have been perfected, however, and rollers of this type have the advantage that licensed steam engineers are not required to operate them and there is no danger of ashes falling on the hot mixture. The use of three-wheel rollers with their greater weight per inch width of tire is also increasing. They are especially useful in rolling the extremely dense, high-stability type of mixture referred to in the first part of this article, but their successful operation requires somewhat more skill than in the case of a two-wheel roller.

Heating wagons for heating tampers, smoothers, etc., in which oil is used as a fuel are supplanting to a considerable extent the old type which burned wood.

Requirements as to the contour of the finished pavement are becoming more and more strict. The surface must be free from any but minor bumps or depressions, in order that smoothness of riding may result and be maintained. Initial unevenness of surface is now recognized as a contributing cause in many cases to the development of waviness. The desired smoothness can perhaps best be obtained by the constant use of a straight-edge while the pavement is being spread and rolled. The narrow limits of variation permitted in modern practice is well illustrated by the following excerpt from the "Standard Sheet Asphalt Specifications" adopted by the American Society for Municipal Improvements:

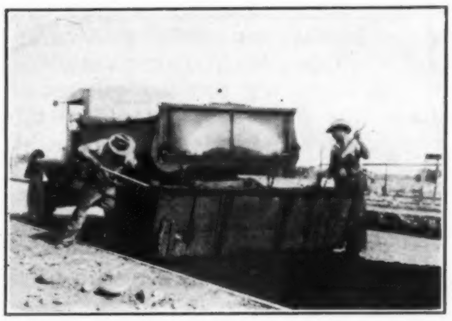
The surface of the finished pavement shall be free from depressions (as measured with a six-foot straight edge paralleling the center line of the roadway) exceeding the permissible depths given below:

Distance between High Points on Which the Straight Edge Rests	Permissible Depths
6 feet	0.250 inch, 8/32
5 feet	0.21875 inch, 7/32
4 feet	0.1875 inch, 6/32
3 feet	0.15625 inch, 5/32
2 feet	0.1250 inch, 4/32
1 foot	0.09375 inch, 3/32

Several instruments for testing the surface of pavements have been devised. Some of them are merely improved straight edges which register the departure from a horizontal plane, while others record the variations on a continuous strip, which may be preserved for record purposes and compared with a similar record taken after the pavement has been subjected to traffic for any desired period of time. Still others are in the form of an attachment to an automobile.

MAINTENANCE AND REPAIR METHODS

The method of resurfacing old pavements has changed but little, except that greater attention is being paid to bringing them to an even contour before putting the pavement proper upon them. The old practice of building up depressions with binder at the time the binder course is being laid has largely given way to a separate operation in which the depressions are built up with suitable material (usually asphaltic concrete) before the pavement proper is laid. This minimizes the bad effect of great variations in thickness in the pavement structure per se.



Spreader Box Attached to Rear of Truck

There has been but little recent change in the methods used for maintenance and repair. Temporary repairs are frequently made with cold mixtures such as Kentucky Rock, Amiesite, etc., or mixtures made with asphalt cut-backs or emulsions. In a few cases municipal repair plants use reheated mixtures made from old pavements, but the extent to which this is done is very small.

The use of surface heaters for resurfacing and some types of repair work is greatly increasing. The pres-

Registering Road Surface Rater

ent type of improved surface heaters is a far cry from the old coke and gasoline heaters used some years ago. They do the work rapidly and economically, and where patches of considerable area are to be covered, successfully eliminate the joints between the old and new pavement, which were unavoidable where the cutting out method was employed and which are always a source of weakness, as they are liable to open up in course of time.

No radical changes have been made in inspection methods. Two inspectors are generally recognized as being necessary, one at the plant to supervise manufacturing operations and one on the street to superintend the laying of the pavement. Preliminary tests of materials and setting of formula are usually made in a central laboratory by men possessed of greater technical knowledge and experience than are required for construction operations. Daily analyses of mixtures are sometimes made at the plant, but it has generally been found better to have the plant inspector devote all his time to supervising the operation of the plant and the making of simple routine tests. Under these circumstances, analyses of mixtures are made at the central laboratory and the inspector receives results of tests, comments and instructions from the technical head of the laboratory, supplemented by such visits as may be necessary.

Refuse Disposal In Providence

A refuse incinerating plant was constructed and put into operation in Providence, R. I. in 1928, as described in Public Works for April of that year. The cost of collecting and incinerating garbage and rubbish in Providence for the year 1928-1929 is shown in the following table, which is based upon an assumed population of 280,600. The city occupies an area of 18.34 square miles. The fiscal year covered by the table began October 1, 1928 and ended September 30, 1929.

	Collection	Incineration	Administration	Total
Cost	$132,665.73	$60,913.34	$6,110.00	$199,689.07
Per cent of total	66.44	30.50	3.06	100.00
Tonnage	38,696.8	38,696.8		
Cost per ton	3.428	1.574	.157	5.159
Cost per capita:				
Day	.001295	.000594	.000059	.001948
Week	.009092	.004174	.000418	.013684
Month	.039399	.018090	.001814	.059303
Year	.47279	.21708	.02177	.71164

This is equivalent to approximately one cent a day for a family of five.

The city has designated the week of April 7th to April 12th as a garbage and rubbish disposal educational week, for the purpose of acquainting the public with the new and improved method of garbage disposal which has been operating for the past two years. During that week the incinerating plant will be open to the public for inspection, with officials of the incinerator department on hand to explain the details of the plant and its operation to the visitors.

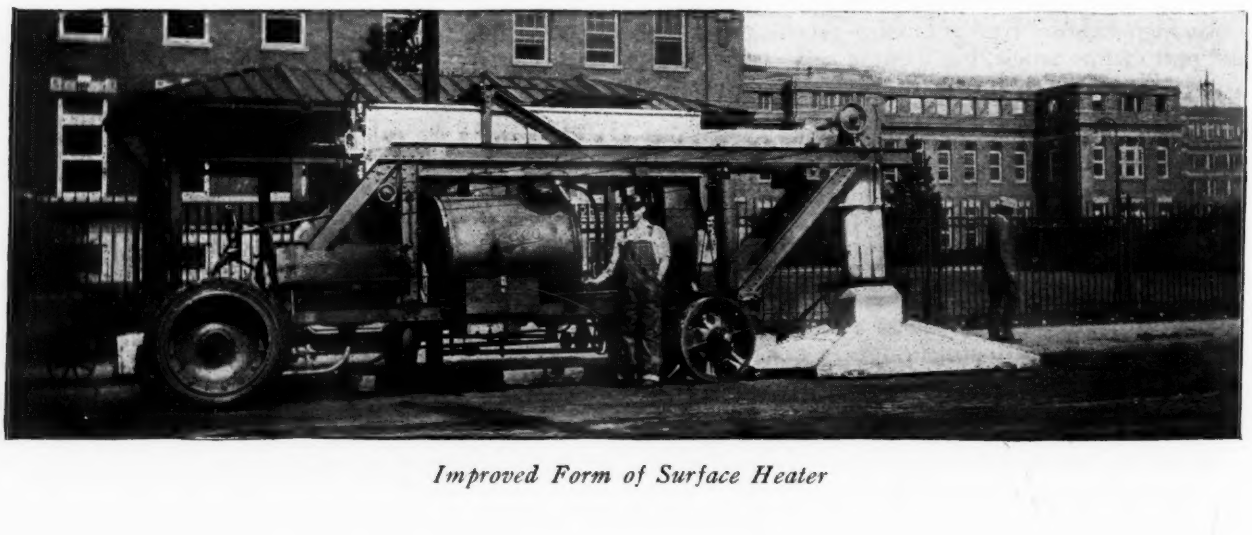
This will be followed by Clean-Up Week, April 14 to 19th. "This Clean-Up campaign is done to place Providence on the map as a clean city," says Irving Stone, superintendent of the Incinerator Department, in a circular he has issued. Householders are requested to clean up their back yards, cellars, attics, garages and sheds and place all the material in an accessible place in the yard, to be collected on the regular collection day by the employees of the incinerator department, placing no garbage or refuse on the sidewalk or street during this week. To avoid littering the yard, sidewalks or streets, it is requested that the receptacles be not overloaded. "All combustible material such as tree brush, old furniture, mattresses, etc., should be tied up in lengths that will not be over 4 feet, to be destroyed at the incinerator.

"The Incinerator Department has only sufficient funds to make the regular collections on the regular days. If the householders and citizens will cooperate and comply with the above suggestions, the department will be able to clean up the entire city without any extra expense to the tax payers or citizens of Providence."

The individual benefits are stressed, the circular saying, "You are the one for whom this clean-up movement has been originated—you and each resident of Providence interested in a clean, comfortable and safe home.—Remember, while your individual efforts help make Providence cleaner and safer, you are the one who benefits most. Cleanliness means safety and health."

The circular also calls attention to the regulation that all garbage be wrapped in paper, which is needed to help burn it; and that all tin cans and bottles be kept out of the garbage and refuse and placed in the ash barrel.

Information concerning recent changes in the pl[illegible] reach us as we are going to press and will appear in the April issue.



Improved Form of Surface Heater

Protecting Highway Bank from Floods

Revetment formed of burlap bags filled with a mixture of sand and cement, tied together with seven-foot steel rods and held by piling at the foot. Special guard rail along the embankment

By R. A. Hamilton*

Route 17, between Johnson City and Endicott, Broome county, New York, at a point about five miles west of Binghamton, crosses from the south side of the Erie Railroad tracks to the north, parallels the tracks for about a mile and then crosses the Erie tracks and the two trolley tracks of the Binghamton Railway Co. to the south side of the latter.

To eliminate these crossings (a grade crossing and a narrow, crooked under-pass) from the through traffic route, a relocation of 1.26 miles of the road was constructed south of the trolley tracks, which here lie south of and adjacent to the railroad right of way. About a thousand feet of this was on a fill along the bank of the Susquehanna river.

In 1927 a contract was let for grading this relocation, building the necessary culverts and other structures, and placing slope protection from Sta. 7+50 to 17+50, where the fill followed the river. This slope protection consisted of wooden piles driven on 10-foot centers about 6 feet inside the natural toe of the new slope, to the inside of which 12x4-inch horizontal sheeting was bolted, extending from the river bed to about two feet above low water—a height of six to 10 feet; the purpose of which was to retain the bottom of the slope. The piles extended about 20 feet above mean low water, and 12x4 stringers were placed about two feet apart from the top of the sheeting to the tops of the piles, and 4-inch mesh heavy steel wire was fastened over the whole structure; the purpose being to protect the embankment from ice and drift wood during high water. Willow limbs, spaced two feet apart from the piles to the top of the bank, were buried six inches below the surface of the slope, it being thought that these would grow and, covering the entire slope, afford a natural protection to the bank. But the willows failed to make any progress, and many of them were lost during high water. This method of protection seeming to be a failure, a different type was devised.

This consisted of driving 105 additional 16 to 18-foot piles between the old ones, thus providing a continuous line of piles spaced 5 feet centers, and cutting all off 3 feet above low water; repairing the old 12x4 sheeting, replacing it where necessary; removing all willow limbs and brush, and dressing the slope and paving it with bags filled with sand and cement.

In the fall of 1928 a contract was awarded to G. De Angelo, of Binghamton for regrading, widening, paving and slope protection of this project. In January, 1929, he moved a ¾-yard Erie steam shovel to the site and constructed a temporary roadway about half way down the slope from Sta. 7 + 50 to 17 + 50, to enable him to drive the additional piles, using the Erie crane with a 40-foot boom to handle the piles and a drop hammer.

The piling completed, the contractor moved the shovel to a borrow pit about two miles from Sta. 9, where he obtained the eight thousand cubic yards required, hauling it to the job with six International and two Brockway trucks. This work was done during the winter.

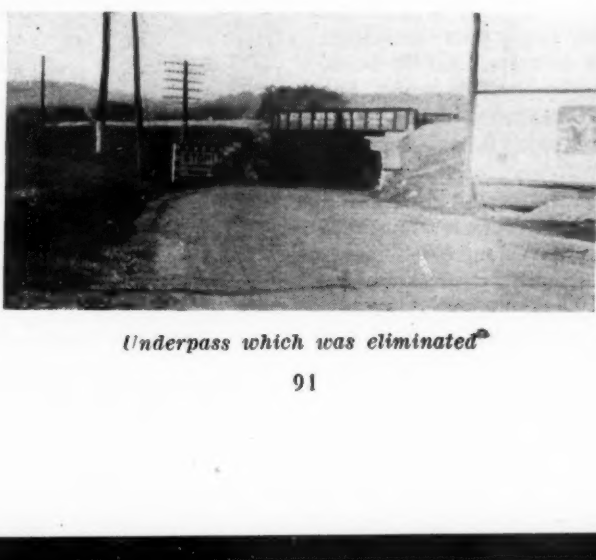
During the last week in March the river rose to within six inches of the subgrade, but did more good than harm, as it settled the material in the embankment and made an excellent foundation for the slope protetction.

Preparatory to paving the slope, the engineer staked it out and set batter boards 50 feet apart, the bottom edges of the boards being set at the surface of the completed revetment, which was sloped 1 on 1¾. The contractor used six men to trim the slope to a surface 8 inches below the batter boards.

The material used in the revetment was a mixture of 1 cement to 4 sand, mixed moist and placed in burlap sugar bags. A Jager one-bag mixer was used. The sand was dumped along the edge of the road and the cement was delivered to the job as needed.

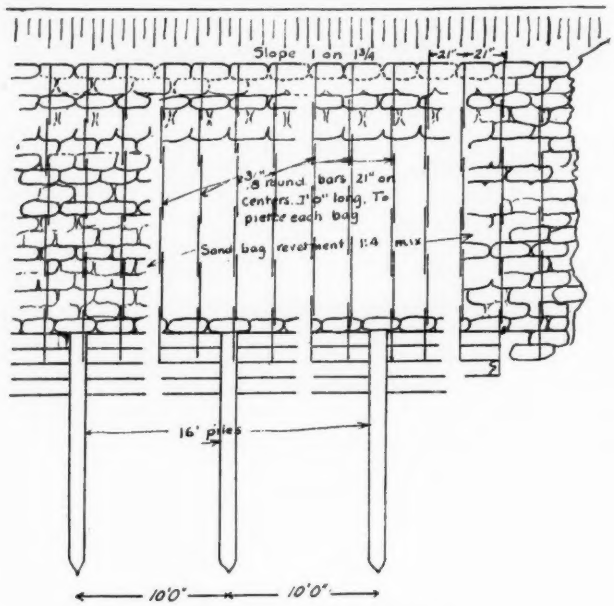
The sand was measured by box into a wheelbarrow and dumped into the skip of the mixer, a bag of cement added and a small quantity of water, and mixing continued for two minutes. The mixer discharged into a chute 6 ft. long which extended out over the bank. A burlap bag was held under the end of the chute and the material shoveled into it until it was two-thirds full, when it was slid down a wide board to men below, who placed it in position. The open end of the bag was folded under and the bag placed on the trimmed earth slope.

The bags were laid as stones would be, breaking joints. When they had attained a height of seven feet, measured up the slope, ⅜-inch steel rods 7 feet long were driven through the bags, parallel to the slope, spaced 21 inches apart and piercing each of the bags. After the next 6 feet of bags had been placed, other 7-foot rods were driven, lapping the first lot 12 inches; and so on up the slope. At the end of a day's work, extra rods were driven into all end bags and top bags

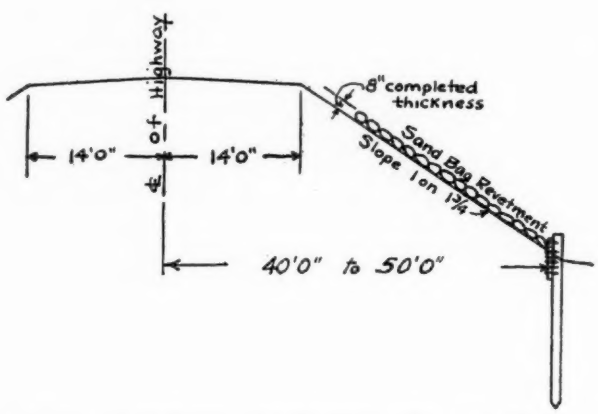


Underpass which was eliminated

*Assistant engineer, Bureau of Highways, New York State Dept. of Public Works.



Front view of bag revetment



Section of highway embankment with bag revetment

and left extending 12 inches, so that the next day's work would be tied to this. As each area of about 150 square feet was completed, the bags were sprinkled and tamped with a heavy wood tamp to the prescribed slope, giving a thickness of 8 inches.

The force used on this work comprised one man to measure and handle sand, one to dump cement, one to operate the mixer, two to shovel the mixed material along the chute into the bags, two to hold the bags and slide them down the slope, two to place the bags in position, one to place the rods, sprinkle and tamp the bags, and two to re-trim the earth slope. These twelve men averaged 100 square yards a day. A total of 3600 square yards was laid, using 22,000 bags, 1250 barrels of cement and 7400 pounds of steel. The bid price was $1.95 per square yard, exclusive of the cement and steel, which were paid for as separate items.

Prior to paving the slope, the contractor graded and paved the roadway, laying a New York State standard 18-foot reinforced concrete pavement 8-7-8 inches thick, built in two 9-foot strips, with 5-foot shoulders. When traffic conditions make greater width desirable, a third strip can be added at small expense.

A gang of ten men did the fine grading, using a 2-ton Brockway truck, a 10-ton Buffalo-Pitts roller, and a light grader. A 6-ton Buffalo-Pitts roller operated between the forms ahead of the mixer at all times. Hotchkiss steel forms were used, anchored with steel pins 24 inches long to maintain line and grade, as the pavement was mostly on new location.

All materials of construction were brought by rail to Johnson City, about two miles from the center of the contract. Stock piles were provided for the sand and stone, but most of the time they were removed from the cars direct to an Erie aggremeter by means of an Erie crane, and batched into trucks divided to carry two batches. Cement was loaded direct from the cars into the trucks, 7 bags to the batch, no store house being provided. The aggregates were hauled to the job over an improved road all the way.

A Foote 27-E paver was used. The mix was 1:2:3½. Nazareth cement was used. Water was obtained from the Johnson City water works, there being a hydrant 300 feet from the east end of the contract, to which the contractor connected a meter and a 2-inch pipe extending the length of the contract, with hose outlets 250 feet apart. No records of laying were broken but a first-class job was obtained.

It was necessary to borrow 4,000 cubic yards of material to complete the shoulders, which was obtained from a borrow bit near by. Ten men with a 6-ton roller and a light grader trimmed and rolled the shoulders.

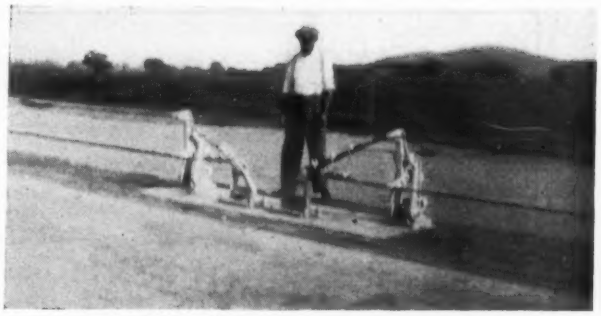
On the 1.26 miles of road, 5600 lin. ft. of cable guide railing, 1277 lin. ft. of Ramsey safety guard rail, and 100 concrete guide posts were placed. This work was sublet to the Cable Guide Railing Co. of Buffalo, N. Y., which furnished all material and erected same.

Ramsey safety guard rail was used on the south side from Sta. 0+95 to 2+12 and 6+45 to 18+05. As the section from Sta. 6+45 to 18+05 includes that portion of the road where the revetment was placed and bordered the Susquehanna river, it was deemed best to increase the strength of the guard rail as much as possible. As originally designed, the posts are placed 16 feet centers on concrete piers 14 inches square and 3 feet 6 inches deep, and anchors are

Revetment built with cement-sand bags

placed on concrete blocks 24 inches square and 3 feet 6 inches deep, the center of the anchor being 3 feet from the center of the end post; each section of rail not to exceed 500 lin. ft. The size of the anchor blocks was increased to give the rail greater resisting power; the end pier and anchor block were cast in one block 4′ 7″ long, 2′ 7″ wide and 3′ 6″ deep, and intermediate anchors were made 9′ 2″ long, 2′ 7″ wide and 3′ 6″ deep. By using this design, the relative position of posts and anchors was not changed. The concrete for the piers and anchor blocks was mixed 1:2:4. The guard rail between these stations was constructed in three sections, 486 ft., 377 ft., and 297 ft. respectively, a total length of 1160 lin. ft. Two intermediate and two end anchor blocks were constructed. One-inch six-strand cable was used. Ramsey posts, anchors, cable and fittings were obtained from the Ramsey Safty Guard Rail Co., of Albany, N. Y.

The road was opened to traffic August 31, 1929, but due to delays the job was not completed until October. The author was engineer in charge. Chas. M. Edward was the district engineer.



Intermediate anchor block for fence along embankment

Cleaning Filter Sand at Purification Plants

Some suggestions for cleaning filter sand were made in a paper prepared for the American Water Works Association by Emil K. Ventre, chemical engineer and bacteriologist in charge of water purification at Monroe, La. He described two methods of treatment, one using caustic soda, the other hydrochloric acid. The former suffices, he said, where alum is used as a coagulent or a water high in organic matter, or where the pH of the filter influent is neutral or slightly below and some of the trouble is due to unicellular algae and protozoa. Where iron and lime are used as coagulent, or where for any reason the incrustant on the sand is mostly carbonate, with not much organic matter, hydrochloric acid is recommended. Where a combination of conditions exist, or in very dirty filters, it is best to use the caustic soda, followed by the acid.

Following alum treatment with sand showing high organic matter, he has used the following method with good results:

Batching plant used in measuring concrete aggregates for revetment

"1. The filter is thoroughly washed, then the water is drawn down to 4 inches over the sand, 500 pounds of 76 per cent caustic soda is distributed over the surface evenly with a spade. Area of filter is 20 by 30 feet.

"2. The solution over the sand is stirred slightly with a broom to effect even distribution of solution and allowed to stand six hours to allow a thorough cleaning, with full-strength solution, of the top and usually most dirty part of sand bed.

"3. With a long pronged (6 to 8 inches) rake the sand is raked back and forth to a depth of 12 to 14 inches, depending on the depth of sand. Care is needed so as not to disturb the gravel. This is done every three hours for twelve to fifteen hours.

"4. At the end of this time the filter-to-waste valve is opened and the water level is dropped to the surface of the sand and allowed to stand six hours more.

"5. The filter is now washed until the wash shows an alkalinity of the wash water applied, then put into service in the usual manner."

The same method is employed in the acid wash, using 10 per cent by volume of commercial hydrochloric acid.

Careful observation should be made to see that no harm is done to the brass laterals.

By experimenting to determine the strength of solution necessary, a considerable amount of algae can be distintegrated by using caustic soda. When using high strength of caustic, always follow by an acid wash and vary the time of contact accordingly.

Method of Treating Side-Hill Streets in San Francisco

In a great many locations in San Francisco, California, streets are laid along the sides of hills so steep that the ordinary methods of grading and paving are impracticable. Not only the grading of the street itself, but that of the streets intersecting it offers considerable difficulty, while along the street itself access to houses and garages on both sides of the street would be impracticable if it were graded in the ordinary manner. These streets are treated generally by division of the street into an upper and a lower roadway, with either a slope or a retaining wall between them. As these occur generally in districts where property values are relatively low, every effort must be made to keep the cost of the improvement in proportion to the value of the land. In many cases these improvements bring such benefits to the city in general that the supervisors aid them by appropriating from the general fund a portion of their cost.

General View of Central Rubbish Station

Collection and Disposal of Wastes in Detroit

Work done; methods, equipment and supervision for each class of work. Methods of disposing of rubbish and of garbage. Cost of collection and of disposal

By John W. Reid*

The collection and disposal of wastes, rubbish and garbage, in a modern city such at Detroit, with its one hundred and thirty-nine square miles of area and a million and one half of population, is a real problem. Because of its political ancestry, the problem of modernizing this service has been found most difficult in practically all of the larger cities. From time to time studies, and recommendations based on such studies, have been made, resulting in some improvement in methods and slightly lower costs. But there still is much to be accomplished.

The Division of Municipal Wastes of the Department of Public Works of Detroit is charged with the collection of rubbish and garbage. The superintendent receives $6,500 per year and the assistant superintendent $4,500 per year. District superintendents are paid $3,120 per year and the annual compensation for foremen is $2,040, $2,160, $2,280, $2,400, $2,640.

This division is operated under two subdivisions, viz: Street and Alley Cleaning, and Garbage Collection.

Of the twenty-six hundred miles of streets in the city, approximately fifteen hundred miles are paved. Of the sixteen hundred and thirty-two miles of alleys, four hundred and fifty-eight miles are paved.

STREET AND ALLEY CLEANING

CLASSIFICATION OF WORK

A—Collection. This entails the picking up of all wastes from residences and business houses. The city ordinance defines domestic and commercial rubbish. (See Appendix.)

B—Flushing and Sweeping. These operations dispose of street dust and small wastes from the street surface.

C—Catch Basins or Pavement Drains—Both hand and machine methods are used in cleaning the more than one hundred and seventy-five thousand pavement drains. Eductors are used principally in the downtown area, where the basins are larger and the frequent flushing of pavements makes necessary more frequent cleaning of basins.

D—Snow Removal. This is an emergency service, the importance of which has multiplied with the city's growth and the tremendous motor vehicle registration and the place such vehicles now occupy as transportation mediums.

DIVISION INTO DISTRICTS

To facilitate supervision, the city is divided into seven districts. The districts are divided into sections: Central, twelve; Southwest, seven; Southeast, six; North, six; West, five; Northwest, nine; fifty-three in all.

The district boundaries are fairly well defined and the type of equipment used in each is regulated for most economical haul. Trailers coupled to loaded trucks are used in the North District, because of the excessive haul to the point of disposal—about twelve miles. In the Northwest District, trucks of twelve yards capacity are used on a nine-mile haul, as compared to a nine-yard truck making a six and one-half mile haul from the Central District transfer station.

TRANSFER STATIONS

There are two such stations. One, known as Northwest Station, equipped with elevated bins charged from the ground by a conveyor, a small furnace for burning bulky combustible materials, and metal salvaging equipment. The other, Central Station, is equipped with bins for storage of materials for transfer.

*Commissioner of Public Works of Detroit

A garbage transfer station, known as Northeast Station, is large enough to be used for rubbish and may be so used unless the development of the Municipal Airport forces the relocation of this facility.

EQUIPMENT

Equipment may be classified as follows:

A—Collection. These units are all hired except the trailer units, which are city owned. The averages of hired equipment are, trucks one hundred and sixty; teams two hundred and twenty-five.

B—Flushing and Sweeping. This equipment is city owned and consists of nineteen flushers and eight sweepers.

C—Basin Cleaning. The city owns three sewer eductors.

D—Snow Removal. All trucks used for transporting snow are hired. The city has five snow loaders, and twenty-six plows mounted to trucks with special brackets.

SUPERVISION

The district superintendent is directly responsible for the work of the foremen of the sections in the district. The number of men, trucks and teams assigned to each foreman depends upon the character and extent of the area served. Trucks are paid at the rate of $21 per day, based on a predetermined number of loads from the section. The labor rate is $4.40 to $5.20 per day.

DISPOSAL

Disposal is in dumps on low-lying lands in the outskirts of the city and along some sections of the river behind the U. S. Government Harbor Line. This is the most economical method under ideal conditons, viz. short haul. Such conditions no longer exist in Detroit. Dumps for such materials are difficult to secure and too far removed for economical use.

A small quantity of materials is salvaged and sold. It is profitable only from the standpoint of reducing bulk for long hauls and the saving in dump area.

Automobile bodies, fenders, large pails and metal containers are costly to haul and a nuisance on the dump. The amount of such materials salvaged each year is approximately 725 tons.

Cost of collection and disposal for the fiscal year 1928-1929 was $2,973,310.81. The total cubic yards collected and disposed of was 2,387,173, the cost per cubic yard being $1.245.

Flushing and sweeping for a period of eleven months, including depreciation and repairs, cost $107,734.

GARBAGE COLLECTION

For this service the city is divided into thirteen districts, varying in area according to the density of population. The central or downtown district is one third of a square mile, composed entirely of hotels, restaurants, stores, and food warehouses. Collections are made here nightly, after midnight, thus avoiding traffic congestion. The collection costs in this district are less than in any other, due to volume and short haul to the main transfer station.

In the other districts, collections are made twice each week in the summer months and once each week in the winter months. Garbage is hauled from each district to the nearest transfer station.

TRANSFER STATIONS

There are four garbage transfer stations: The main station, located on the river front two miles from the City Hall; three in other sections of the city distant

Top—N. W. Station. Garbage Transfer Ramp in Rear
Bottom—Tin Cans Baled. N. W. Rubbish Bins and Conveyor at Left

Top—Automobile Scrap at North West Station
Bottom—General Scrap Pile at N. W. Station

from the main station from four to ten miles. All of these stations are of the gravity type, no machinery being used to aid in handling loads. The main station has a raised concrete platform thirty-six feet wide and two hundred feet long, with pits fifteen feet wide on each side where special steel gondola cars are placed by the disposal contractor to receive the garbage from the motor trucks.

The other stations are smaller. Large trucks and trailers are used in the pits and receive the garbage from the smaller collection units.

EQUIPMENT

The city owns and operates all collection equipment. Both trucks and trailers have their own dumping devices. There is no handling of tanks or truck bodies by crane or otherwise.

For household collection:

121—2 cubic yards, end-dump trucks
34—4 cubic yards, end-dump trucks
3—5 cubic yards, end-dump trucks
12—7 cubic yards, end-dump trucks

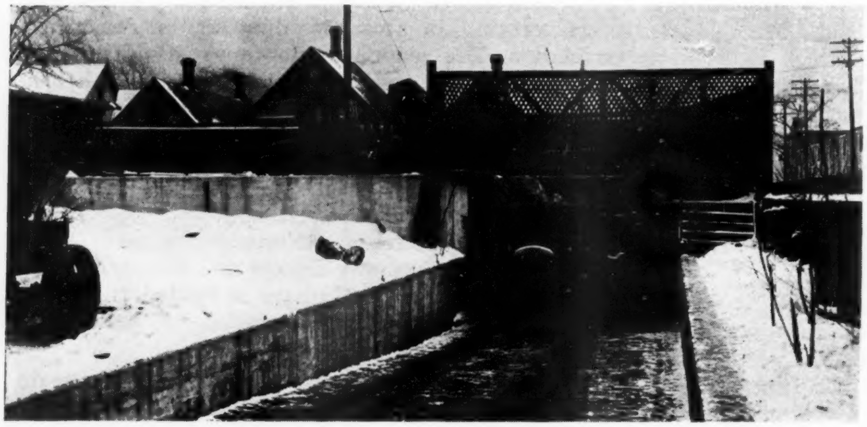
For transfer duty:

10—7 cubic yards, side-dump trucks
11—7 cubic yards, side-dump semi trailers
14—7 cubic yards, side-dump semi trailers

Most of this equipment is operated two shifts per day in the summer months, in order to maintain twice-a-week service in residential areas.

SUPERVISION AND LABOR

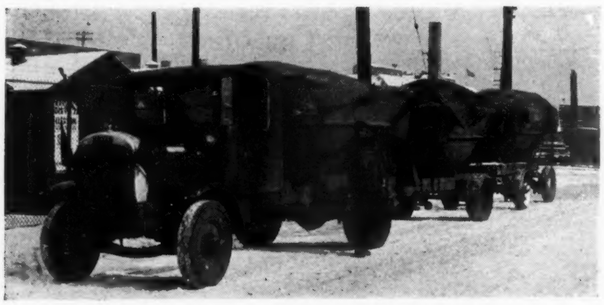
The collection of garbage is in charge of the assistant superintendent of the Municipal Wastes Division. He has one district superintendent and four-

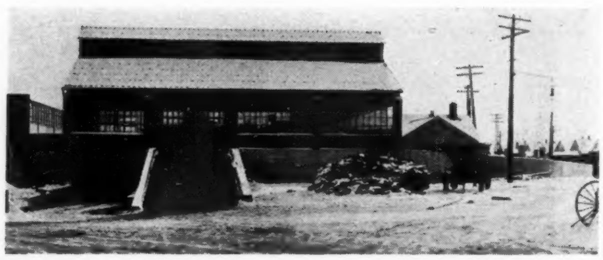


At Left—Garbage Transfer Station at Orleans and Wilkins. Collecting Trucks Discharge From Above Into Large Trucks in Runway Below

Below, Left—A Three-Unit Garbage Truck

Below, Right—Garbage Transfer Station at Buena Vista and Terminal Railroad





Some of the Trucks (Fruehauf make) Used for Collecting Detroit Garbage

teen foremen. During the cold months 450 men are employed, and 600 men are required in the warm months of the year. The scale of wages paid both drivers and helpers is 84⅓ cents per hour for eight hours; time and one-half is paid for time in excess of eight hours, and double time for the seventh day if worked. All employees are given a two weeks vacation for each year of continuous employment.

COSTS OF COLLECTION

The cost of collection for the year 1928 was $1,121,707.46, or $7.05 per ton. This includes labor, maintenance and improvements. A total of 159,038.15 tons was collected.

DISPOSAL

Disposal is taken care of by a private contractor, whose plant is located twenty-six miles south-west from the center of the city. The contractor pays the freight from the main transfer station to the plant and receives from the city $2.25 per ton for all raw garbage delivered to him. The total cost, to the city, of disposal for 1928 was $357,835.83. This, with the collection costs, makes the total cost of this service $1,479,543.29, or $9.30 a ton.

The department has in its current budget an item of $250,000 for the first of four or five incinerator units. It is proposed to use this method for rubbish only at present, but later it is hoped that both garbage and rubbish may be disposed of in this manner. A request for $250,000 to cover the cost of a second unit is being included in the 1930-31 budget.

Garbage Transfer Station at French Road

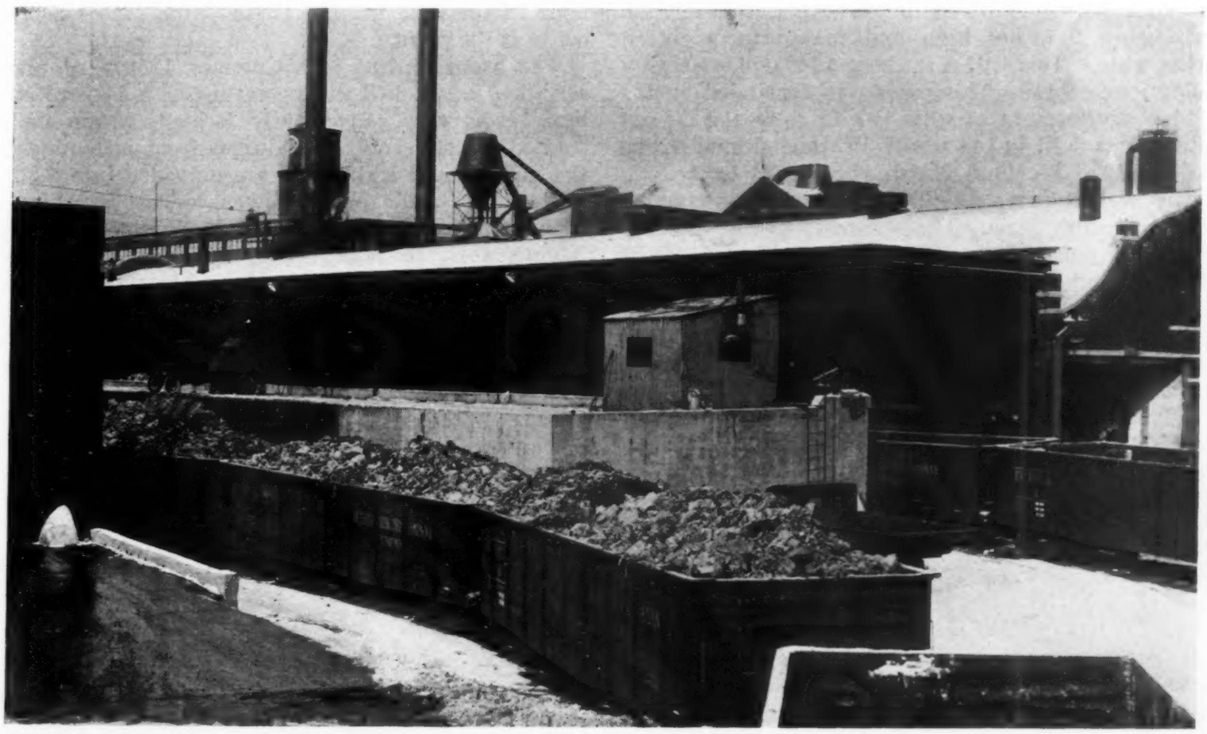
APPENDIX

Definitions of Terms Used in Classifying Wastes

An ordinance which went into effect September 3, 1926, defines "Waste" as including all materials classified by the ordinance as garbage, rubbish, ashes and paper. Each of these classes shall be kept in a receptacle separate from the others.

"*Garbage* is all waste animal or vegetable matter incident to the use and storage of food for human consumption, spoiled food and dead animals found within the city limits, except food containers, tin cans, paper, oyster and clam shells, crockery, glass ware, manure, grass, leaves or twigs."

Receptacles for garbage may be either portable or stationary; must be watertight and vermin-proof; and of sufficient number and capacity to hold a week's garbage, at least 3 gallons per family. The garbage must be drained but not



Garbage Transfer Station at Jefferson and 24th Street

wrapped in paper. If portable, the receptacle shall be of metal with a handle and tightly fitting cover, not more than 15 gallons capacity nor weighing more than 100 pounds when full. Stationary receptacles "shall be provided with an opening from which contents are emptied that shall extend from the bottom across the full width of the receptacle and shall be fitted with a door hung so it will remain open without interfering with collection."

These and all other receptacles "shall be located within private property lines," except that if the property does not abut upon an alley, portable receptacles may be placed at the curb upon the day scheduled for collection.

"*Domestic rubbish* is the miscellaneous waste materials resulting from the usual routine of housekeeping except garbage and ashes, and excludes the wastes of building construction, alteration or repair, and earth or dirt, limbs or stumps in excess of five feet in length or one inch diameter."

"*Commercial rubbish* is the miscellaneous waste and materials resulting from the operation of mercantile enterprises and includes packing boxes and cartons, excelsior, paper and rubbish from offices, stores and mercantile establishments.

"Waste from building construction, alteration or repair, and earth or dirt from excavations, and unusual or special manufacturing or trade wastes are not classed as commercial rubbish."

Manure is classified as commercial rubbish, and its removal charged for as such, except that it will be collected free after it has been used on lawns of private residences.

Rubbish receptacles may be portable or stationary, of metal or wood, weighing not over 100 pounds when full. Stationary ones shall have doors as specified for garbage. Rubbish too large for receptacles may be tied in bundles weighing not more than 100 pounds each.

Paper, dry and free of other refuse, may be tied in bags or bundles weighing not more than 100 pounds each.

Collection is as specified for garbage, with the additional provision that if the building extends to the alley line, permit may be obtained for placing the receptacle in the alley.

"*Ashes* are the residue of any fuel after combustion. Ashes may contain oyster or clam shells but shall not contain tin cans, metal, paper, crockery, glass, wood or other material not a residue after combustion."

Ash receptacles are to be as specified for rubbish, and of size and number adequate to hold two weeks' accumulation of ashes—for a private dwelling, not less than one bushel for each 2,000 cu. ft. of building or 5 bushels per family. Wood containers must not be used inside buildings nor for fixed receptacles.

Clean ashes may be piled loose in unpaved alleys abutting the property.

Collection of garbage and other domestic wastes is made without charge; also of manure that has been used on private lawns, and clean ashes or cinders suitable for filling if the Department of Public Works has need of them for that purpose.

Commercial rubbish is collected "upon surrender of tickets sold by the Department of Public Works at the rate of 20 cents per barrel. No collectors shall be paid except by commercial rubbish tickets."

Paving in a Small Louisiana Town

Ambitious paving program for small town. Simple but effective method of grading troublesome gumbo soil. Asphalt plant conveniently situated and efficiently operated.

By E. B. Johnson

Rayville, Louisiana, a town of three thousand people, is paving three miles of its streets, laying about 57,000 square yards of Warrenite bitulithic on a five-inch concrete base, with combined curb and gutter, the curb being 6 inches high and the gutter eighteen inches wide. This will cost about $240,000, or eighty dollars per capita. This paving is demanded by the sudden development of what is said to be the largest natural gas field in the world, in which Rayville, the parish seat of Richland Parish, is centrally located.

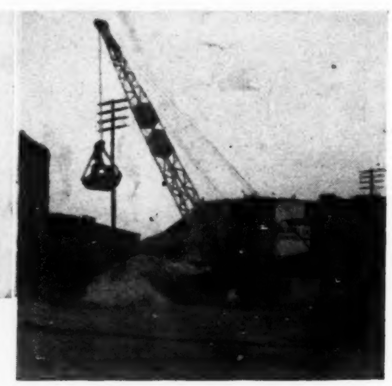
The work is being done by the Merrill Construction Co., of Jackson, Miss. The chief difficulty it encountters is the gumbo soil, an average of a foot depth of which is to be removed over the entire area. This material is very hard when dry, but when wet is sticky and slippery and almost impossible to work on. The contractor is excavating it successfully by plowing it with a common plow hitched to a 2-ton Holt tractor or an Austin road-grader, then scraping the loosened material into piles and hand-shoveling it into 1½-yard Superior steel dump bodies mounted on Ford trucks. It is being used to fill low lots at varying distances from the work. The graded subgrade is rolled with a small Kelly Springfield road roller.

The concrete for both pavement base and curb and gutter is mixed 1:3:6, using sand from Shreveport, more than 130 miles away, and gravel from Monroe, 25 miles away. A Foote 21-E mixer is used. Expansion joints are placed at 6-foot intervals in the curb and gutter, and between this and the concrete base, but none in the base itself. These joints are of asphalt made at the plant.

The asphalt plant is a Cummer 1250-yard plant, served by a 10-ton Koehring crane and a 24-ton Butler bin. It is very conveniently located, within the V formed by two railroad sidings, from one of which the cars of sand and gravel are unloaded into the bin or to piles, while on the other cars of asphalt are brought alongside the plant. Also, it is central to the paving work, the haul being seldom over a quarter-mile. The crane does all shifting of cars.

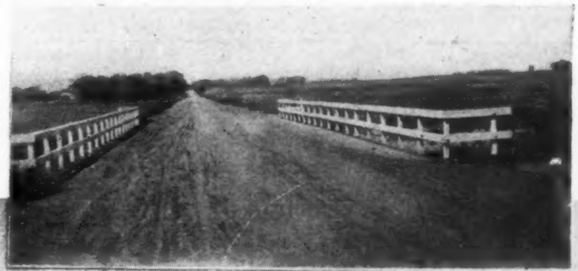
Trucks are run under the mixer and loaded directly. The hot stuff is spread by hand to give a 2-inch top, and rolled by a 12-ton Buffalo-Springfield roller.

Loosening and Scraping Gumbo Soil Preparatory to Paving

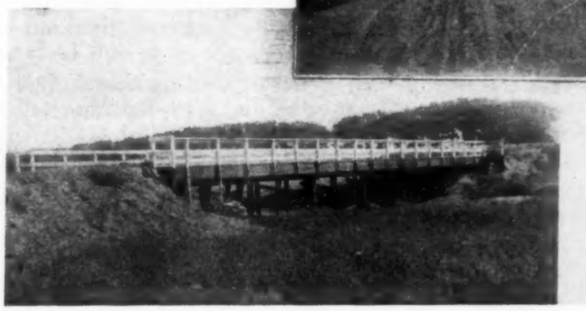


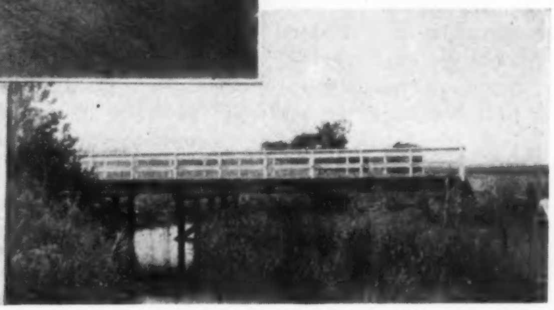
Above—Crane, Bin and Asphalt Plant
Right—Crane Unloading Cars

At Right — Creosoted Timber Bridge With 24-Foot Roadway Continuous With Surface of County Road Crossing It



Below — Typical Reno County Creosoted Timber Bridges; Left, 90 Feet Long; Right, 60 Feet Long





Creosoted Bridges in a Kansas County

By W. A. Stacey*

A recent Kansas law provides that all bridges on township roads of over five-foot span shall be constructed, maintained and reconstructed by the county. In those counties which are traversed by many streams, this addition to the bridges on county roads offers a problem which may be dealt with only after consideration of the amount of money annually available for such work.

Reno county has an area of 1257 square miles and contains 250 miles of county and 1947 miles of township roads. It has 5100 lineal feet of bridges on county roads and 19,100 lineal feet on township roads, or a total of 24,200 feet of bridges.

The stream channels are shallow and wide, with easily eroded banks, usually not over 10 feet high. Their beds are ordinarily sand or mud to a depth of 30 feet. The runoff is light during most of the year and drift in flood periods is usually small.

Four years ago there were very few permanent bridges of any type in this county, practically all structures being untreated pile timber trestles. At that time a creosoted timber bridge of 24-foot roadway was adopted as standard for all new county road bridges. This width of roadway was necessary on account of the wide farm machinery, particularly the wheat harvester-thresher, so common in this region. This type of bridge was selected because of its adaptability to our local conditions and because of its economy and ease of construction during any season.

The bridges are of the trestle type and, excepting the handrail, built entirely of timbers and piling treated with 12 pounds of creosote oil per cubic foot by the empty cell process. Each bent consists of five piles capped by a 10-inch by 10-inch timber and carrying a double set of 3-inch by 8-inch by 24-foot sway bracing. Span lengths are usually 15 feet and 17 feet center to center, with thirteen and fifteen lines of 4-inch by 14-inch stringers respectively for a 24 foot roadway. The floor is built of 3-inch shiplap and is covered with 4 inches of sand-clay surface to protect the floor from traffic. This surface is held on the bridge by a 4-inch by 8-inch retainer at each side.

The abutments also are made of 3-inch shiplap for water tightness. All pile cutoffs are treated with hot oil and two layers of burlap and bitumen. All bolts are painted and all nails galvanized. The untreated handrail is given two coats of white paint and repainted thereafter whenever necessary. The sand-clay wearing surface is bladed by the patrolman along with the rest of the road and therefore has a good riding quality.

All timbers and piles are sound southern yellow pine and the stringers have an added specification of passing the density grading.

These bridges are constructed by the county's forces, one crew devoting its entire time to this work. This outfit is equipped with cook-shack, bunk house, pile driver and hoist, jet pump, two trucks, air compressor, etc. All equipment is mounted on trailers. The lengths of bridges usually built range from 30 to 200 feet.

The county also has two other bridge crews that build concrete or creosoted timber culverts and repair the township road bridges recently taken over.

By the end of this year, it is expected that the construction of permanent drainage structures on county roads will have been nearly completed. Beginning with next year, we will enter a ten-year program to replace all untreated timber bridges on township roads with ones of creosoted timber. These will be similar in design to those already built on the county roads except that they will have only 20 feet clear roadway. They will, however, have a low handrail to permit the passage of wide farm machinery. The cost of the creosoted timber bridges of 24 foot roadway built to date has averaged $35 per lineal foot. This includes all labor, material and rental on equipment.

We believe that these structures will serve us for 30 years under our conditions, with little maintenance.

*County engineer, Reno county, Kansas.

Airport Construction and Maintenance in 1930*

Airport construction and maintenance will afford, in 1930, a greater field than ever before for the construction industry. This field will not be a narrow one, in which but one or two lines of construction will find opportunity to partake. The work necessary in the construction of a modern airport includes clearing and grubbing, grading, paving, construction of runways, drainage, water supply, sewerage, lighting and power and housing. In addition, in many instances, the airport itself will be but a nucleus around which other construction will center, or it will be a primary cause of added construction.

The greatly increased activity that will take place during the coming year is due, primarily, to the rapid growth of the aviation industry. More airports are now necessary, just as a generation ago, more roads were necessary; and also, as has been the case with roads, it is now necessary to provide for traffic both heavier and of greater volume. Airplanes are becoming more numerous; transport planes are becoming heavier; and passenger planes are demanding smoother take-off and landing facilities. These combine to require more airports and an added degree of construction refinement and facilities.

Proposed airport construction activity may therefore be classified under two heads: 1. New Construction; 2. Improvement of fields now in use.

NEW CONSTRUCTION

Volume: The increase in the volume of airport construction is best reflected by figures which have been prepared by the Aeronautics Branch of the Department of Commerce. As of January 1, 1929, there were on record as proposed for construction in 1929, 899 airports. As of December 4, 1929, there were on record as listed for construction in 1930, 1,361 airports. This represents an increase in the total number of airports to be constructed of 51 per cent; but the real increase in dollars and cents of work done will undoubted exceed this percentage materially, because the airport of 1930 represents a considerable increase in size, capacity, safety and completeness over its predecessors, even those of a year ago.

Costs: To get an idea of the amount of work involved in these figures, the question may be asked: "What do airports cost?" There is, of course, no real standard of measurement; yet figures are available from a large number of cities where both municipal and private airports have been constructed within the past year or so. Reports from 17 cities, having a total population of more than ten million, show a per capita cost of somewhat more than $2.50 for airport construction, with a variation ranging from slightly over $1 per capita for Richmond, Va., Chicago, Ill., and Boston, Mass., to $10 for St. Paul, Minn., and $14 for San Diego, Calif.

Construction Volume: Based on these figures, the probable expenditures for airport construction in 1930 may be estimated at not far from $75,000,000 exclusive of improvements to fields now in use.

Fields in Use: Last year, for the first time, private fields reached a par in number with municipal fields. At the end of 1929, there were in existence 1,561 airports of all types, of which 84 were Army, Navy and other Governmental fields, 528 were intermediate and auxiliary fields, 458 were municipal fields, and 491 commercial fields. It may be expected, therefore, that during 1930, the bulk of construction will be in commercial fields. In general, the municipal field was designed to fill the gap until the commercial field became feasible financially. In many places this is now a fact, and consequently the volume of municipal fields may be expected to decline though many fine municipal fields are now being built.

IMPROVEMENT OF FIELDS NOW IN USE

Factors in Increased Expenditures: The principal factors which tend toward increased expenditures for airport construction in 1930, aside from the increased number of airports projected, are those which result from the necessity of making airports better able to handle the rapidly increasing volume and weight of air traffic. These include grading, drainage, paving, lighting, building, and similar features. Some or all of these become necessary when the emergency landing field, or the Class C or D airport, is made over to meet the requirements of new air mail or transport lines or increased volume of air travel.

Grading: In constructing an airport, the field should have a grade not exceeding 2½ per cent and preferably not over 2 per cent. In some sections of the country, where large areas of level land are common, grading does not involve any considerable expenditure; but in most places it is an important item. In the construction of the Akron airport, the grading amounted to 1,300,000 cubic yards, on which the price was 34 cents; the rolled embankment amounted to 90,000 yards, on which the price was 22 cents a yard. The grading work at Port Columbus, Ohio, cost only $31,500 for clearing and grading, which is comparatively low. Thus the cost varies with individual cases, but on the average airport may amount to a considerable figure. Much depends upon the topography as to the cost and the equipment that must be employed, but usual types of earth moving apparatus are ordinarily suitable for the work.

Drainage: Drainage may be classified as an essential factor in any airport. The surface of the ground must be firm at all times. Water cannot be allowed to remain on the ground even for a day. Airport drainage must be designed so as to be able to carry away water from the landing areas as fast as it falls. In many cases subsurface drainage also must be provided in order to control the ground water. At the Columbus airport subdrainage lines were built at 30 to 60-foot intervals. In all about 32 miles of drains were built.

Without adequate drainage, airports may be out of service or unsafe for one-fourth to one-third of the time.

The cost of drainage varies much with local conditions, but standard practice of design in storm and underground drainage should give information on this

* A paper by W. A. Hardenbergh, Associate Editor of PUBLIC WORKS, before the American Road Builders' Association meeting at Atlantic City, N. J.

point. At Port Columbus, Ohio, drainage costs were about 11.5 per cent of the total cost of $800,000. At Akron, subdrainage was not needed, but the storm water drainage system is reported to have cost $180,000. On the great airport being constructed outside of New York on the Jersey meadows, drainage will be an important consideration.

Paving: Increased traffic and the heavier transport types of planes being put into service is now resulting in a marked demand for paved runways. These are needed so that shorter take-offs will be possible; also the air-traveling public demands better take-offs and landing. Paved runways for the airport should be at least 100 feet in width, and the minimum length under most conditions is 2,500 feet. Paving such a runway requires in the neighborhood of 28,000 square yards of paving, and where two or more runways are to be paved, this amount will be increased accordingly. At Port Columbus, O., asphalt on a concrete base was used, and the cost for two runways, totaling over 90,000 square yards of pavement, was $135,000.

In the past, relatively few airports have had paved runways, but the indications point plainly to the fact that in the near future dustless and substantial runways suitable for all kinds of weather conditions will be required: paving is even now almost an essential in the better fields. What the type of paving will be, is not now known, but the type chosen will have to be capable of withstanding heavy loads at high speed. In other words, it will be a hard surface, high cost pavement.

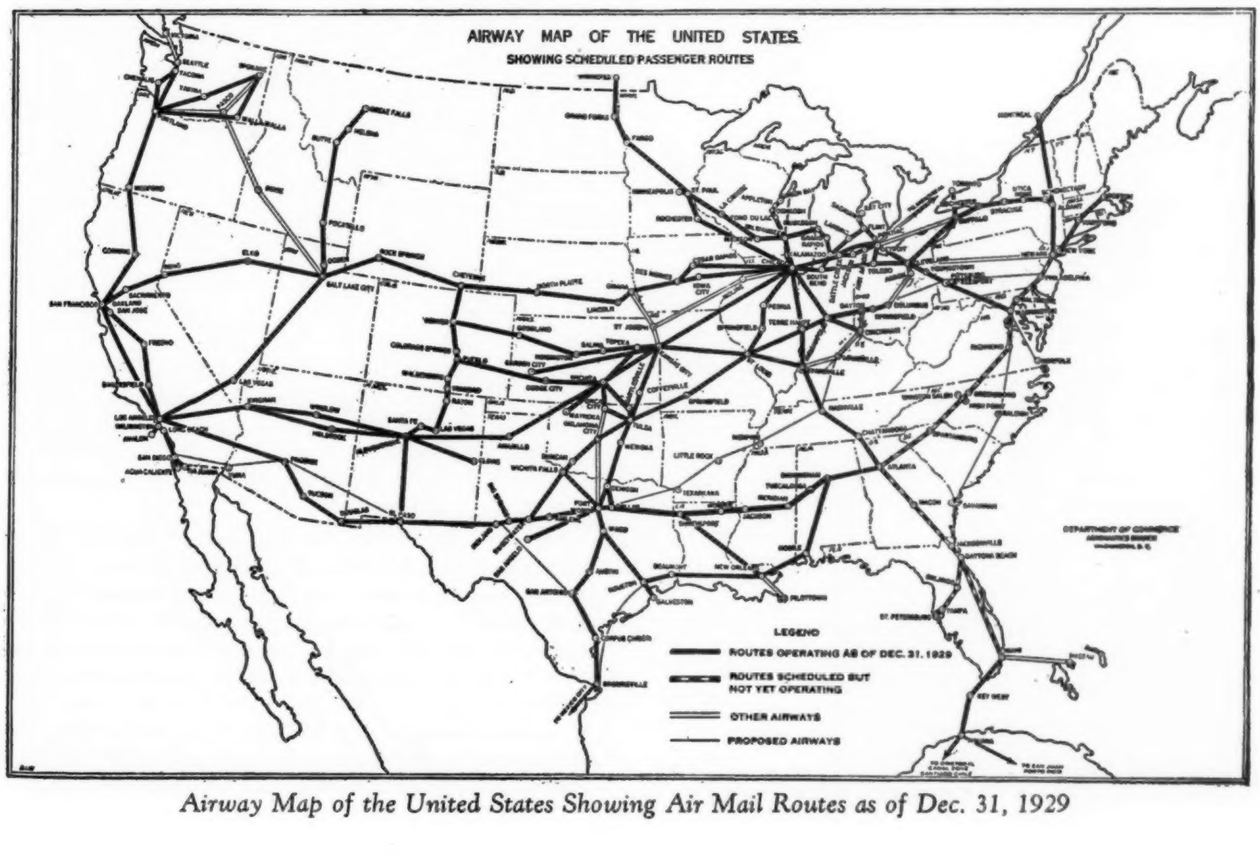
Water Supply and Sewerage: With passengers and employees in increasing numbers at airports, provision for water supply and sewerage must be made. Airports are frequently beyond the economical reach of water and sewerage lines from nearby cities, and generally must they be provided with systems of their own. Frequently treatment plants must be provided. The costs for these facilities depend entirely upon local conditions.

Lighting: With the great increase in night flying, lighting has become an essential. Marking of the edges of the landing field and of obstructions; flood lighting; and many special devices for aiding the flyer are now common. The construction of such lighting equipment represents a very considerable cost. The Department of Commerce estimates that the cost of constructing a lighting system for a field of standard size and construction will run from $12,000 to $35,000 and may be expected to average around $25,000.

Housing: In addition to the cost of building the hangars, there is also the expense involved in the construction of the shops, houses for pilots and personnel, buildings for restaurant and hotel facilities, and other structures. A recent tendency is to make the modern airport provide recreation facilities, including tennis, swimming, golf, etc.

Other Construction: A heavy-traffic high-speed type highway is generally a requisite for communication between the airport and the city it serves. Frequently it is more economical to build such a road than to locate an airport near an established good road, where land prices may be high or where the road already carries maximum traffic. Provision for parking according to size of town and traffic past the port must be made.

Summary: Airports to be constructed in 1930, numbering nearly 1400, will exceed by 50 per cent the number constructed last year. In volume of work, construction will be considerably greater. In addition to the work resulting from new airports there will be a large amount of work because of improvements to existing airports, such as paving, water and sewerage, drainage and improved lighting and housing.



Airway Map of the United States Showing Air Mail Routes as of Dec. 31, 1929

Draglines and Industrial Railways, Tractors And Trailers in Levee Construction

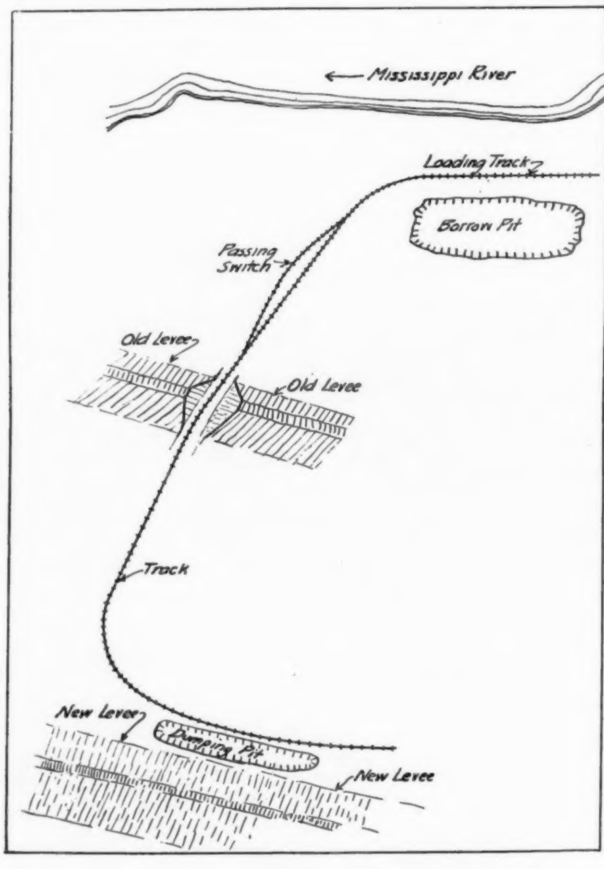
The two former used by one contractor, the two latter by another nearby. Electric fresno and other equipment

The use of draglines and industrial railways on an extensive levee construction contract was described by J. C. French in the May, 1929, issue of PUBLIC WORKS. Since that article was written, the Canal Construction Company, Chicago and Memphis, has secured additonal contracts for levee construction in the vicinity of Cormorant, Miss., and now has very extensive equipment on the job.

There are also other pieces of work in the vicinity where other methods of construction are being employed, which offer interesting comparisons in the equipment and construction details being used.

The general plan employed by the Canal Construction Co. is to use an industrial railway to haul dirt from a borrow pit to the levee. A dragline is used at the borrow pit to load the cars, which dump into a pit or trench at the toe of the levee, from which the dirt is placed in the levee by another dragline. It is also sometimes necessary to employ an additional smaller dragline on top of the levee to dress out and complete it.

An important point in the use of this equipment is the arrangement of the tracks for the industrial railway. As used mainly on this job, the trackage consists of a single track line running from the borrow pit to the levee, which is approached by a wide curve or loop, finally paralleling the levee; at the borrow pit end there is usually a switch to allow for the use of two trains, one loading while the other is dumping. The sketch illustrates a typical layout of trackage as used by this company.



General Lay-Out of Construction Track at North End of Canal Construction Co.'s Job

The equipment on the job totalled sixteen draglines from 1 to 3 yards in capacity, all Deisel engined; eleven industrial locomotives, all gas driven; and fifty dump cars of 4, 5 and 6 yards capacity. Of these four are Continental 6-yard cars; seven are Western 6-yard; eight are Western 5-yard; and thirty-one are Western 4-yard. There are five 4-ton Vulcan locomotives; three 8-ton Vulcans; two Plymouth 8-ton; and one Plymouth 10-ton.

The draglines used comprise a wide variety. At the north end of the contract, five or six draglines are employed. A passageway has been cut through the old levee—the present job is a new loop levee—to reach a borrow pit near the river. At this borrow pit is a Bucyrus 30-B 1-yard dragline loading the cars. As a train is filled, it is hauled about a thousand feet to the new levee. At a siding near the borrow pit is a string of empties which are moved by one of the small locomotives to the dragline. The loaded train dumps into a pit and the dirt is handled on to the levee by a Bucyrus 50-B 1½-yard dragline.

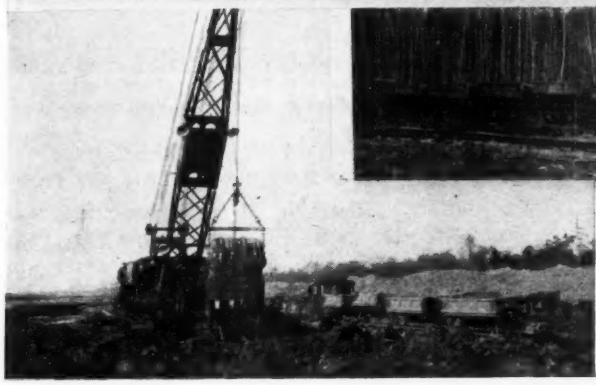
A short distance south, a section of the levee slipped, and is being built up again. On this job are three or four draglines and a short section of industrial railway, the borrow pit being inside the old levee, and the haul only a couple hundred feet. Loading into the cars from the borrow pit is by a P & H No. 600, 1-yard dragline. This dirt is emptied into a pit and rehandled by a Monighan 3-yard walking dragline which throws it up to a Bucyrus 50-B dragline working on the crown of the levee.

In addition to this equipment, there are in the north end of the job a couple of caterpillars and a small Farmall tractor used for pulling stumps and clearing the ground. During a part of the time there was also used in this section a P & H 700 crawler dragline carrying a 1½-yard bucket.

On the south end of the job, there were two Indusrial track units operating in the same general manner as that described above, and a third unit operating part of the time. A passage has been cut through the old levee and two borrow pits opened not far from the river. At one of these a Bucyrus 1¼-yard dragline loaded into the cars, which hauled to a pit from which dirt was handled by a Monighan 3-yard walker into the levee. At the other of the pits, a P & H 700 dragline with 1¼-yard bucket did the loading, and the

haul was somewhat under 1000 feet. The dirt from this job was handled by a Monighan 2-yard dragline, which placed it in the levee.

A third industrial railway unit was used part of the time, serving the larger Monighan dragline. This



Top: Monighan 3 Yd. and Bucyrus 50B Finishing Levee. Middle and Bottom: P. & H. Draglines Loading Into Cars

Above: Canal Construction Co.'s Bucyrus 30 B Dragline Loading Train

At Right: Train Dumping Into Pit at Toe of Levee

was loaded with a P & H Model 800 2-yard dragline.

In addition to these machines, there were several other machines engaged in dressing up and completing the various sections of the levee. These included a 3-yard Monighan, a 2-yard Monighan, a Bucyrus 1¼-yard, and a P & H Model 900, equipped with a 2½-yard bucket.

The great difficulty on a contract of this type is in securing such coordination that all equipment is operating all the time.

JONES & RODGERS CONTRACT

Somewhat north of this contract is that of Jones & Rodgers, located near Walls, Miss. The methods employed on this contract are very different from those described in preceding part of this article. Jones & Rodgers are using the tractor-trailer teams loading the wagons with an elevating grader. On the job are six "60" Caterpillar tractors. Two of these handle the elevating graders, both of which are Russell machines. One of them has the new power take off, and one is axle drive. The other four tractors haul the four 7-yard Western wagons, which are the dirt movers on this contract. Borrow pit conditions on this contract have been very bad and necessitated working back and forth along the contract to find the least difficult working conditions. Despite this, good progress has been made.

The power-take-off elevating grader does practically all the loading work on this contract. It has replaced two of the old type of grader.

SOMETHING NEW IN DIRT MOVING

On a portion of piece 38, near the above contract, the Kaiser Paving Co. is subcontractor for about 100,000 cubic yards, which it took at 24.7 cents a yard. On this work it has employed a new type of machine, called an electric fresno, five of which are on the job. This machine is loaded, hauled and dumped much like the old fresno. It is mounted on crawler wheels, and has a capacity of about 14 cubic yards. When it is desired to fill the machine, an electric switch is closed, depressing the nose, which scoops up dirt as it is pull-

At Right: P. & H. No. 600 Dragline Loading Train at Borrow Pit

ed along. As the bucket, which is constructed of telescoping sections, fills, the sections open, permitting better and more complete filling. When the load has been completed, closing of another switch returns the machine to its original position. After reaching the levee, closing another switch telescopes the bucket and dumps the load, which is spread in a 6-inch or 8-inch layer.

Borrow pit conditions, as shown in the illustrations, were terrible on this contract, and it is doubtful if many other kinds of equipment could have operated.

Though not entirely suited for this type of work, the Kaiser fresno does give promise of being well adapted to various conditions of levee construction.

This firm also used a variety of other machinery. There was one "100" Cletrac tractor which operated alone one of the big fresnoes and gave satisfaction over a long period of hard work. There were six Caterpillar "Sixty" tractors, and three Monarch "75" tractors equipped with Atlas Imperial Diesel engines.

Diesel-driven Monarch Tractor Hauling Kaiser Electric Fresno on Kaiser Contract

Top—Cletrac 100 *Hauling Loaded Kaiser Fresno Up Levee. Background Shows Borrow Pit Conditions*
Middle—Tractor and Fresno in Borrow Pit, Showing Conditions
Bottom—Borrow Pit Viewed from Levee

OTHER WORK IN THIS SECTION

Piece No. 36, in this vicinity, was let to R. H. McWilliams Co., Inc., Memphis, Tenn. The contract was for 255,000 yards at 24.9 cents and consisted of landslide enlargement, converting the old levee to the new "B" section. This work was completed early in September. G. C. Weathers, Jr., Greenville, Miss., subcontracted about twenty stations of the work, with the assistance of C. J. McFarlin.

Weathers' outfit was composed of one Northwest shovel with a 1-yard bucket, which was used to load four 7-ton Western crawler wagons pulled by Monarch and Caterpillar tractors. McFarlin used an elevating grader pulled by a Monarch tractor to load nine 1¼-yard Western dump wagons hauled by mules. Borrow pit conditions were bad here much of the time.

PERSONNEL

All the work described in this article lies in the Third Field Area of the Memphis Engineer District, of which Lt.-Col. F. B. Wilby is district engineer. H. V. Pittman is area engineer; W. T. McKie is inspector in charge of the Upper Yazoo Levee District, in which this work lies. On the work at Norfolk Landing, being done by the Canal Construction Co., inspectors have included Paul V. Fairley, E. H. Johnson, T. O. Stark, C. R. Stark, and H. L. Moore. On Pieces 36, 37 and 38 inspectors include C. A. Beardsley, J. A. Myover and Wm. C. Huber.

A Method of Frost Boil Cure

Used successfully in treating gravel roads in St. Louis County, Minnesota

By S. B. Shepard*

Due to the location of St. Louis county, Minnesota, very little is known about its road problems, although a great many people know that it is noted for its large iron ore deposits. The county is sixty miles wide and one hundred and twenty miles long, bigger than several of the eastern states.

A large proportion of the county is undeveloped land—in other words, cut-over timber lands. It is a pioneer territory in process of settlement and improvement, and we are just beginning to learn the adaptations of its soil and climate.

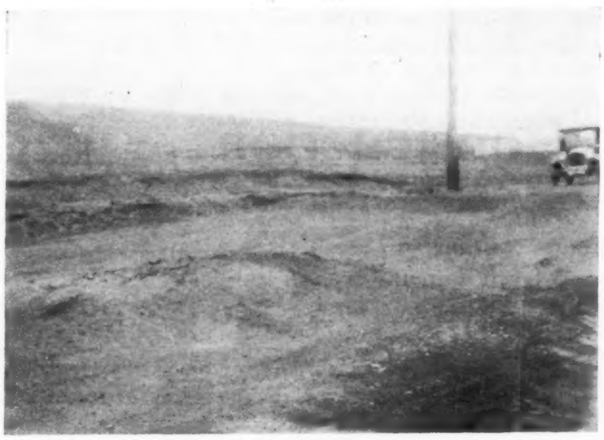
Most of our own people do not yet realize how rapidly the county is going ahead. Forty years ago what few roads we had were trails through the virgin timber which were traversed by means of pack sack and pack horses. Today, we have approximately three thousand miles of highways opening up this vast country to the settler.

Most of the money comes from dairy cows and laying hens. Due to a rapid growth in dairy farming, highway work in St. Louis county has had a sudden growth, for the product of the farms must be delivered daily to the market, and our roads must therefore be passable at all times of the year.

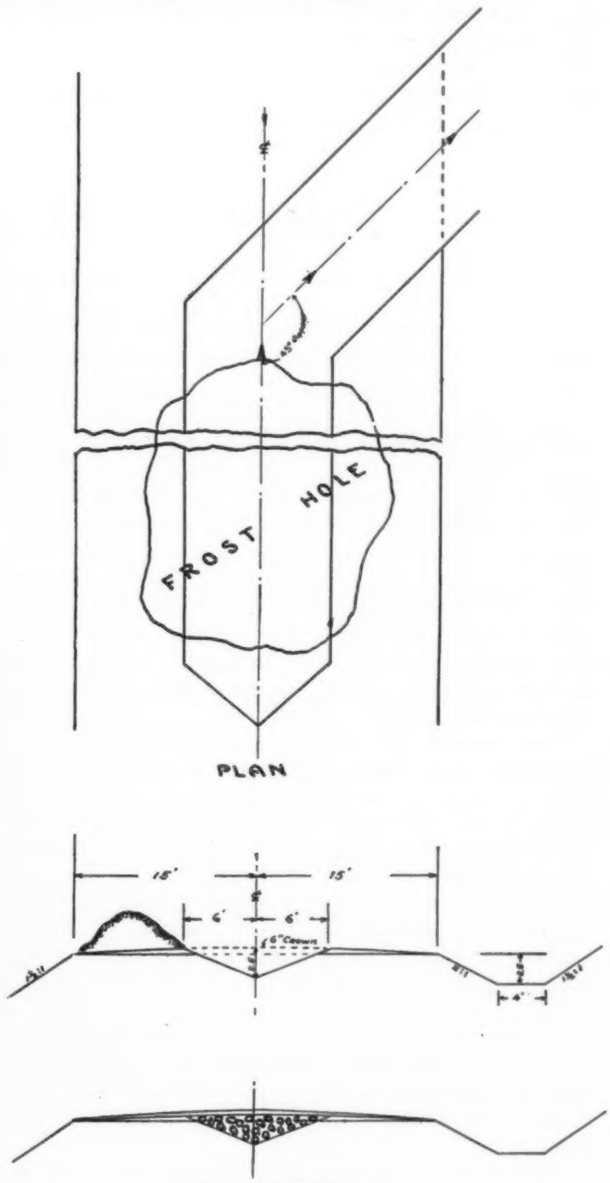
Our snow plowing in the winter months causes the frost to penetrate to a depth of about seven feet, which means slow frost removal in the spring of the year, especially when the ditches are filled with snow. This deep frost, coupled with our peculiar glacial drift soil, causes this county a great deal of expense during the break-up in the spring, largely because many places blow up or become soft and impassable during this break-up.

The two views show the beginning of these frost boils, or blow-ups as we call them.

*Chief Highway Engineer, St. Louis County, Minn.



Results of Frost Boils in St. Louis County



Sketch Showing Method of Treating Frost Boil

We have been experimenting with different methods of cure, but until the year 1928 failed to cure them all or completely, although we had tried drain tile, and porous back-fill in nearly every form and manner we could think of; also had used considerable perforated culvert pipe with fairly good results.

Our best and most economical results have been where we cut a "V" shaped trench down the center of the road and filled it with large gravel. This is illustrated by the sketch. By use of a large tractor and twelve-foot blade, the roadway is cut out to a depth of approximately two and one-half feet. The material is thrown out on one side of the road as shown in the diagram, thus allowing traffic to use the highway during the entire operation.

St. Louis county is fortunate in that there is plenty of gravel in the surrounding territory. Inasmuch as most all of our roads are gravel surface, we have a big program of gravel surfacing each year. In many of our pits we can afford to use only a screening plant, and do not crush the rejections from this. This large gravel is used to fill this "V" trench and is levelled off with blade and tractor. The excavated material already stored at one side of the road is then bladed back over the top of the "V" trench. We then shape up the road, which is at a trifle higher elevation than it was formerly, add screen gravel to the surface and allow traffic to do the remaining work of compacting the surface.

The frost boils very seldom appear except at the mouth of cuts or at top of grades. This allows us to carry the trench to discharge into the ditch at a point lower down on the grade.

Where we have used farm drain tile to cure these frost boils, we have gone below frost line with the flow line of the tile and then filled the trench to within two feet of the surface, using the excavated material to complete the backfilling. This has cost between $1.25 and $1.56 per lineal foot of trench, depending upon the length of haul for our coarse aggregate. Five miles is the longest haul made so far.

The trench method has cost from 51c to 65c per lineal foot of trench, plus the cost of resurfacing the road with gravel. The gravelling has not been charged against this work, as we considered it a surface replacement charge which will last over a period of years.

By taking care of the frost boils in this way we hope to keep the markets open to the farmer three hundred and sixty-five days in the year.

Safety in Dam Construction

Some of the uncertainties in design and construction and methods suggested for solving them. Lessons to be learned from dam failures in the past

A paper with this title was read by Allen Hazen before the World Engineering Congress in Tokio last November. In this paper the author outlined, and suggested methods of solving, some of the uncertainties in design and construction of dams which have caused failures of such structures. He stated that, although there are thousands of dams in the United States, thirteen of more than one hundred billion gallons capacity each, thousands more will yet be built, many of them larger and higher than any yet constructed.

The number of failures and partial failures of American dams during the past few years is evidence that too many of them have not been strong enough, which is not creditable to the engineering profession and indicates that practice in regard to dam construction must be improved. Several of the dams which failed were designed and built by engineers who occupied high positions in the profession, which suggests that there must be some weak point in the engineering philosophy upon which they were designed.

"Histories of dam failures indicate that there are sources of weakness in great masses of materials not readily inferred from experience on a smaller scale with the same or similar materials;" which seems to indicate that models are not a sufficient guide in this case.

The author considered masonry dams of both straight and curved gravity section, and arched, and buttressed; rock fill dams; and earth dams, dry filled with masonry core or clay core, or placed by hydraulic fill. The largest part of the paper was devoted to the subject of masonry dams.

Gravity masonry dams may fail by overturning or by sliding. In early discussions it was assumed that a dam safe against overturning would be safe against sliding; but the engineers in those days had dealt mostly with strong granite rock in dams of comparatively low head. High masonry dams which have fallen have nearly always slid without overturning; although it may of course be possible that the dams would have overturned had they not slid.

In discussing the section of masonry dams, the author assumed masonry weighed 150 lb. per cubic foot, and the theoretical triangle section of such proportions as to maintain the line of thrust in the middle third of the base or of any horizontal section of the dam.

Assuming there is no upward thrust of the water offsetting a part of the weight of the masonry, this requirement will be met if the section of masonry above any horizontal plane is at least $0.323\ h^2$ in which h is the depth of water on that plane. However, it is not safe to assume there will be no upward pressure of water, and the author recommends assuming such pressure ranging from full pressure of water (due to the head up to the spillway level) exerted at the heel of the dam, and diminishing to nothing at the toe. Under these conditions the required section of masonry is $0.422\ h^2$. A considerable part of this upward

pressure, although not all of it, can be removed by draining the dam and the rock under the dam and carefully grouting under the heel.

In making comparisons of dam sections in this paper, the author uses the coefficent of h^2 (or area of section divided by h^2) as a basis.

A dam in which the computed line of thrust reaches the limit of the middle third of the base has been said to have a factor of safety of two; but this is on the assumption that the dam will turn as a whole on the edge of the toe, which is clearly impossible, and he believes that such condition should be considered to have a factor of not much more than one. Under such condition, either masonry or rock at the toe would yield, and the stress on the vertical face would be zero and a slight increase of stress would cause a tension at this point with the result that the joints in the masonry would open, admitting water and resulting in rapid destruction. It is true that many dams designed on the above theory have not failed, but others so designed have failed.

Some masonry dams have a footing in a deep cut, so that the dam cannot slide on the rock, and any movement means shearing of the masonry higher up, as near the original ground surface.

"Looking at the matter broadly and thinking of the dams that have failed by sliding, it looks as if the tendency to sheer and the resistance to sheer had been in most cases the dominating elements in determining whether a masonry dam would stand or fail."

The water pressures to the flow line in front and upward on the base are not the only pressures which the dam must meet. Some of the others are: "1. Added water pressure from occasional increased water levels by flash boards and in floods. 2. Ice pressure, not existing in the south but something to be reckoned with in the north. 3. Pressure of silt deposits. 4. Impact waves in a heavy wind. 5. Earthquake shocks. All of these will never act at once, but proper allowances for some of them must be made in every case."

To give an idea of the effect of the first three of these additional stresses upon the thickness of dams, the table on page 108 is presented.

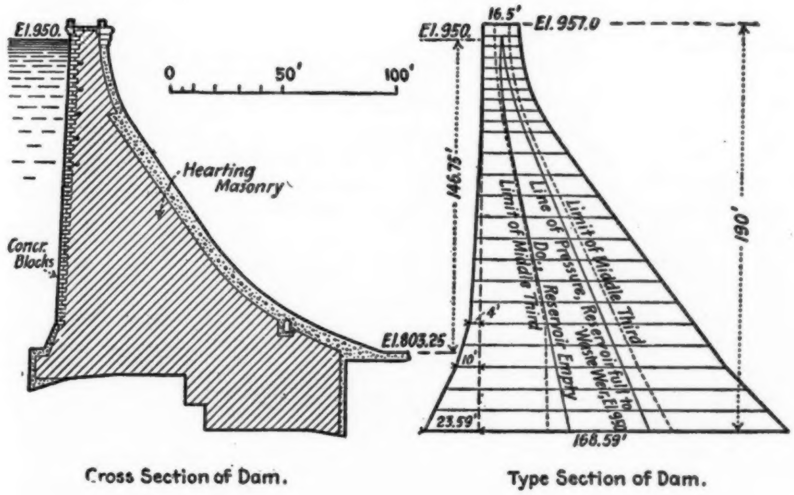
Allowance for ice pressure and flood height would never be used simultaneously. The pressure of silt in the table is equal to double water pressure for an assumed depth of 50 feet. Its amount would depend not only upon the depth of the silt, but upon its solidity and resistance to lateral motion after standing and compacting. The allowance shown is probably a maximum for that depth.

"Some of the profiles given as types to be followed in the well-known Wegmann book on dams do not differ very much from the minimum section which brings the line of pressure to the limit of the middle third, and the St. Francis dam of the city of Los Angeles which recently failed by sliding was only slightly heavier than it."

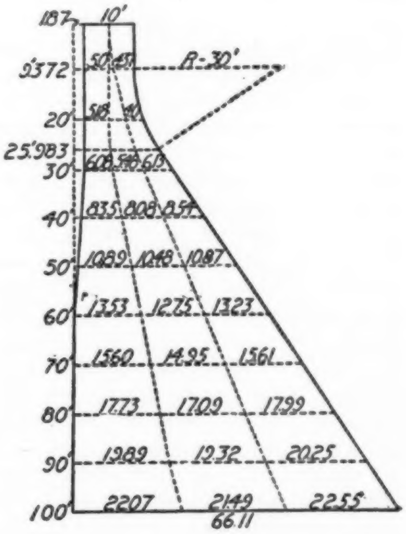
The late F. P. Stearns, in an unpublished report in 1918, stated that "no one at the present time would approve designs of new dams having such limited cross-sections." That such dams have not been regarded as safe by some of the most competent engineers is further evidenced by the fact that the Wachusett, Kensico and Ashokan dams have sections approximately equal to 0.52 h^2, or about 60% more than the minimum section. The resistance to overturning increases as the square of the thickness, and these dams are therefore more than twice as strong against overturning as dams of minimum section. "They would carry, with the line of thrust at the limit of the middle third, the pressure from a liquid with a specific gravity of 1.5 with full upward pressure (two of them are built with drainage and galleries to make such upward pressure impossible), or of a liquid with a specific gravity of 2.5 when protected from upward pressure.

"As these dams are among the heaviest relatively that have been built in America, they may be referred to as of maximum section. It is to be noted that most masonry dams in the United States lie between the limits of the maximum and minimum sections as thus defined."

These heavy dams were undoubtedly built so heavy because the engineers who designed them did not consider the minimum section to be safe. It is a question whether all the other dams that have been built to the minimum section and still stand are suffi-



Cataract Dam, New South Wales. Cyclopean Masonry, 811 Feet Long. Completed in 1908. Lines of Pressure Fall Inside Middle Third at All Elevations

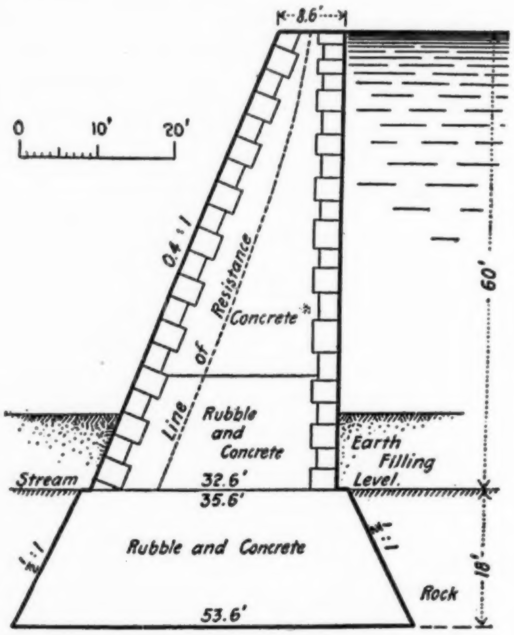


Wegmann's Practicable Section

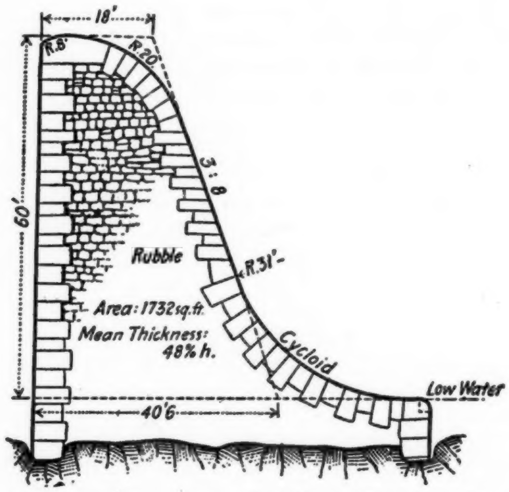
Table Showing Percentage of Additional Masonry Required Because of Silt and Ice Pressure and Additional Water Pressure above the Spillway.

Height of dam to spillway	Silt 50′ deep, with pressure double water pressure		Ice Pressure at Spillway Level: 10 tons per lin foot		Ice Pressure at Spillway Level: 30 tons per lin foot		Flood Heights above Spillway Level: 5′		Flood Heights above Spillway Level: 10′		Flood Heights above Spillway Level: 20′	
	Over-turning	Sliding	Over-turning	Sliding	Over-turning	Sliding	Over-turning	Sliding	Over-turning	Sliding	Over-turning	Sliding
25	—	—	102	102	220	309	31.5	44	65	96	141	223
50	41.4	100	33	25.6	82	76.8	15.8	21	31.5	44	65	96
100	6.1	25	9.2	6.4	25.5	19.2	7.6	10.2	15.8	21	31.5	44
200	0.8	6.2	2.4	1.6	7.0	4.8	3.8	5.1	7.6	10.2	15.8	21
400	0.2	1.5	0.6	0.4	1.8	1.2	1.9	2.5	3.8	5.1	7.6	10

In computing the increase for flood heights, it is assumed that the dam is of a shape to hold the entire flood. In a spillway section the proportionate increase would be less, especially where the proportion of height of spill to height of the dam was considerable. The percentage additions apply directly whatever factor of safety may be used and whatever allowance for uplift may be made; it being assumed however that the change in conditions does not change the uplift pressure.



Boyds Corner Dam, New York. Length, 670 Ft. Completed 1870. Light Section Gravity Dam.



Austin, Texas, Dam. Rubble, 1,125 Ft. Long. Completed 1892. Failed in 1900 With 11 Feet of Water Over Crest

ciently safe. Several such dams have been reinforced in one way or another and it may be that similar treatment may be wisely applied to the others. It may be recognized that in populous communities and where damage by breaking would be great, dams should be made heavier than under other conditions.

The accompanying table shows some of the fundamental figures for weight and pressure for two dams, each holding water to a depth of 100 feet, one of which is the minimum section computed so that the line of thrust comes at the limit of the middle third without allowance for upward pressure, and the other for a dam of maximum section substantially equivalent in relative size to the Wachusett, Ashokan and Kensico dams. In each case 41.6% of the weight of the masonry is assumed to be lifted and removed from contact with the base by the amount of upward pressure. "From the standpoint of friction quite as much as from that of overturning, it is important to provide drainage in and under a dam to reduce the amount of upward pressure to the lowest possible limit. . . . Evidence as to actual water pressures under and in dams is inadequate, but such evidence as can be found points strongly to the idea that the assumption . . . that the upward pressure varies from full water pressure under the heel to nothing under the toe, is safe but not excessive.

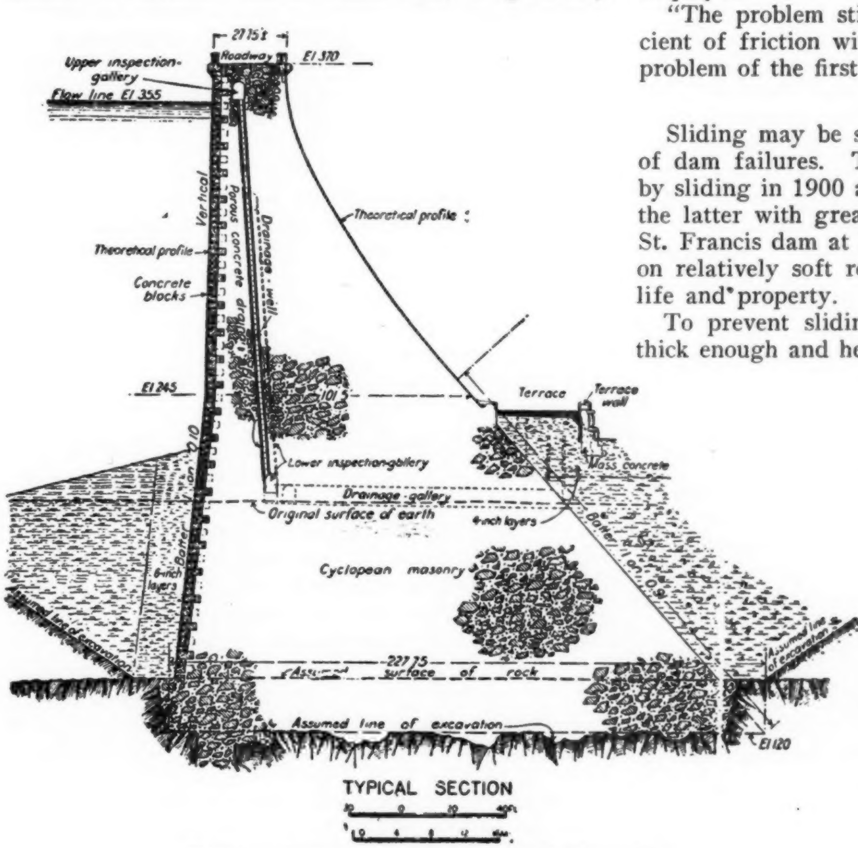
	Dam of minimum section	Dam of maximum section
$A \div h^2 =$	0.323	0.520
h=	100 feet	100 feet
Area section sq. ft.	3,230	5,200
Width of base, feet	64.6′	104′
Water pressure, lbs. (62.41 lbs. per cu. ft.)	312,000	312,000
Wt. of masonry @ 150 lbs. per cu. ft.	484,500	779,800
Upward pressure from below, ranging from full pressure to nothing, averaging one-half, lbs.	201,600	324,500
Wt. of masonry carried on foundation with water pressure	282,900	455,300
Friction		
Required coefficient of friction, no upward pressure	0.644	0.400
Required coefficient of friction with upward pressure	1.103	0.685
Shear		
If the water pressure is carried by shear equally distributed, the stress per square inch will be, in lbs.	33.54	20.83

"Pressures observed under actual dams in most cases fall somewhat below this assumption but not suffi-

ciently below to make a smaller one safe. Most new dams are provided with interior drainage and when this is accompanied by careful grouting of the rock under the heel, upward pressure should be reduced to a minimum. It is difficult to imagine a large masonry dam in which such interior drainage is not advantageous.

SHEAR

"Shear is measured by the force required to break the material at the bottom, whether rock or masonry, and to start movement; and friction is measured by the force required to move the dam forward after the contact is broken. Shear comes first, is generally



Kensico Dam—a Typical Heavy-Section Dam

greater, and it is shear that really holds many or most dams in position."

The coefficient of friction is independent of height, while the shearing stress increases in proportion to the height. For the 550 foot dam now proposed to be built across the Colorado river, the shearing stress would be 185 lbs. per square inch for the minimum section and 115 lbs. for the maximum section. To design a dam of such height which would limit the shearing stress at the base to such amounts as are found in dams which have stood and are recognized as safe would result in considerable thickening of the dam at its lower part, with change in the profile.

Engineers generally have agreed that no allowance for shear should be made in design but that friction alone should be sufficient to hold the dam with a proper factor of safety; but here comes the trouble—if we look at existing dams and, ignoring shear, assume that existing pressures are held by friction, it will lead to co-efficients not in accordance with the facts and not safe for higher dams.

FACTOR OF SAFETY

The author suggests that, with reference to both overturning and sliding, a factor of safety can be obtained by calculating the dam as though required to hold the pressure from a fluid having a specific gravity of two where a factor of safety of two is desired, three where a factor of three is desired, etc.; the dam being designed to resist such pressures while meeting all the conditions now commonly applied in designing dams for water pressure only. The author does not suggest what the factor of safety should be in various cases, but merely that this method of applying it be employed.

"The problem still remains to find the true coefficient of friction with shear eliminated, and this is a problem of the first magnitude."

SLIDING

Sliding may be said to be the most common cause of dam failures. The dam at Austin, Texas, failed by sliding in 1900 and one at Austin, Penn., in 1911, the latter with great loss of life and property. The St. Francis dam at Los Angeles, Calif., in 1928, slid on relatively soft rock foundation with great loss of life and property.

To prevent sliding it is necessary to make dams thick enough and heavy enough to produce the requisite friction on the bases; the problem being to find out what the required thickness and weight really are. It is evident that no general rules can be laid down and the best we can do is to examine all evidence pertinent to the case in hand and then to use in connection with it an adequate factor of safety.

"The masonry dams that have slid have not been far from the minimum section previously defined, and when they have slid the weight of the material moved was about 1.55 times the actual water pressure. The ratio would vary a little for the various cases, but not widely. We must conclude that in these cases water pressure was able under actually existing conditions to move masonry to the extent indicated.

"Other dams of similar dimensions still stand on materials that presumably have greater resistance to shear." Many examples may be cited to "teach that proportions learned from examples of one height may not be safely applied to greater heights because of the reduced influence of shear and because the coefficient of friction, with softer rocks at least, may decrease as the height and pressure increase. If we desire a factor of safety of two with rocks of the character on which slides have occurred and for dams of corresponding height, it is evident that the weight and volume of the dam must be at least doubled, making the weight 3.1 times the water pressure to be resisted. The question of whether or not a factor of safety of two is needed or is enough remains for debate.

"How much this proportion of 3.1 to 1 may be reduced for dams built on rocks of superior character may also be debated. There is little real evidence at

the moment to help us. . . . The most helpful data at present are to be obtained from a study of actual slides of all descriptions. The coefficients actually applicable to them may be estimated more or less closely in certain cases. The information so derived may be applied to cases where it is applicable, using always some factor of safety. Data of this kind cannot be expected to produce precise results, but such study along broad lines is the most promising method of attacking this difficult problem."

Sewage Treatment at Lake City, Florida

The commissioners of Lake City, Florida, in April, 1929, accepted plans for a new sewage treatment plant prepared by George W. Simons, Jr., consulting engineer, and on April 24th awarded a contract for constructing such plant to the Noel-Topping Company of St. Petersburg; this contract including not only the complete treatment plant, but also the installation of 12,000 lineal feet of laterals, with outlet trunk line—everything except the pumping plant, which was awarded to the Burford, Hall & Smith Company of Atlanta. Work on the plant was started during May and was accepted by the commission during October of last year.

The plant is located in a large wooded tract about 3500 feet south of Lake Hamburg and 1500 feet west of Alachua Road. Because of the value of water front property on the lake and adjacent streams, a high degree of purification seems desirable and the plans called for a preliminary bar screen, a primary clarifier, pump house with wet and dry well, dosing tank, sprinkling filter, sludge digesting tank, secondary clarifier, chlorinating equipment, and a sludge drying bed. The design was based on a population of 3,000 with an average daily per capita flow of 100 gallons and a maximum flow of 150 gallons.

The sewage first enters a small screen chamber, where grate bars with 1½-inch clear openings are provided, inclined at an angle of 60 degrees with the horizontal. The coarse particles collecting on this are removed at frequent intervals and placed on a horizontal grating at the top of the chamber which permits them to drain out. The sewage then flows through a clarifier equipped with a new Dorr tractor-type clarifier, 24 feet square with 7-foot water depth at the side, giving a retention period of two hours on average flow. The effluent from this flows to the pump well, where duplicate pumps, each with a capacity of 300 gallons per minute against a 20-foot head, lift the sewage into a dosing tank equipped with a 12-inch Miller automatic syphon, which discharges onto a sprinkling filter 90 feet by 92 feet in plan with a depth varying from 6½ to 7½ feet. The effluent from this tank passes to clarifier No. 2, which is identical in design with No. 1, except that it is 20 feet square. A Wallace & Tiernan vacuum type chlorinator is installed in the pump house and provisions are made for the pre-chlorination or post-chlorination of sewage when necessary. Settled sludge from clarifier No. 1 is pumped, by means of a Dorrco diaphragm sludge pump, into a sludge digestion tank near by, which is circular with an inside diameter of 24 feet and a sludge depth of approximately 15 feet, equipped with a Dorr stirring mechanism.

The cement used was of Florida manufacture, made in Tampa, but the coarse aggregate for the concrete and the filtering medium for the sprinkling filter both were imported from outside the state; gravel from Montgomery, Alabama, having been used in the concrete, and slag being used in the filter furnished by the Birmingham Slag Company of Birmingham, Ala.

The sprinkler was constructed with drainage channels in the bottom, about 16 inches apart between center lines. On top of the ridges, separating the channels and at right angles to them, was laid the false floor of cement brick, 1⅛" wide x 4" high by 17" long, which were set on edge with spaces of about an inch and a half between bricks. On this floor was placed 2147 cubic yards of washed slag ranging from 4" size on the bottom, to a size varying from 1½" to 2¾" on the top.

The main pressure line from the dosing tank to the sprinkling filter distribution system is a cast-iron pipe varying from 16" diameter to 6", from which are led off nine distribution laterals extending across the filter from one side to the other, diminishing from 6" at the main channel to 3" at the extremities. These laterals are spaced 9.4 feet on centers, and at intervals of 10.75 feet on each are risers equipped with type C Pacific Flush Tank Co. sprinkler nozzles. This cast iron distribution system is placed approximately one foot below the top surface of the slag.

Stream Pollution by Textile Wastes

The subject of stream pollution by textile wastes was discussed by Robert Weston before the Boston Society of Civil Engineers some weeks ago. Following discussion of polluted rivers and sources of pollution, Mr. Weston suggested certain remedies, expressing the opinion that problems involving industrial sewage should be considered from the standpoint of the stream and not from that of individual plants. The plants, of course, must be considered ultimately as individuals, but should be treated as groups, and the formation of conservatory districts or river boards was recommended.

Many efforts have been made in the past to establish standards of permissible pollution, with little success, but it seemed to him that an attempt should be made to maintain the dissolved oxygen at above 30% and better above 50% saturation at all times.

Not all textile wastes require purification, and a great saving may sometime be made by separating in the mill the harmless wastes from those which should be treated. Information concerning the purification of textile wastes which are objectionable is extremely limited, and this is a matter which states should investigate much more extensively, appropriating funds to their State Health Boards or others for carrying on such investigations.

In the cases of some streams and some wastes, plain subsidence alone may suffice, while others may require treatment on filters. So far, single filtration has not been always effective, due to the antiseptic character of some of the wastes to be treated or to the kind of substances discharged. Subsidence followed by double filtration has generally produced excellent results but is an expensive process. Unfortunately, the activated sludge process does not appear to be applicable to waste with suspended solids of so low a specific gravity as is to be found in certain textile wastes.

Paving City Streets in 1929

Tables compiled from information furnished us by the engineers of more than nine hundred municipalities, showing areas and square-yard costs of the several kinds of pavements laid on their streets last year.

Replies were received last month from more than nine hundred engineers or other officials in charge of paving of cities of all sizes, down to those of four thousand according to the latest census; this being fifty per cent of all municipalities credited with that population. These replies gave the areas of each kind of pavement laid last year, and the cost per square yard, which information is given in tabulated form on the following pages.

In these tables, bituminous concrete includes "pavement in which bitumen is mixed with the aggregate before being laid," and bituminous macadam is that "in which the bitumen is applied after laying."

There seems to be special interest just now in the prospects for public work construction during 1930. We therefore asked those who have assisted us by furnishing this information to forecast, as well as they were able, the amount of work which would probably be done by their respective cities, giving the kinds of work in prospect and the amounts which would probably be expended, together with the corresponding amounts spent on similar work in 1929. Naturally, many could not furnish definite information concerning 1930 work so early in the season; but about four hundred were able to do so, and the very valuable figures so furnished are used as the basis of a special discussion of the subject presented in connection with the tables.

Sheet Asphalt Laid in 1929

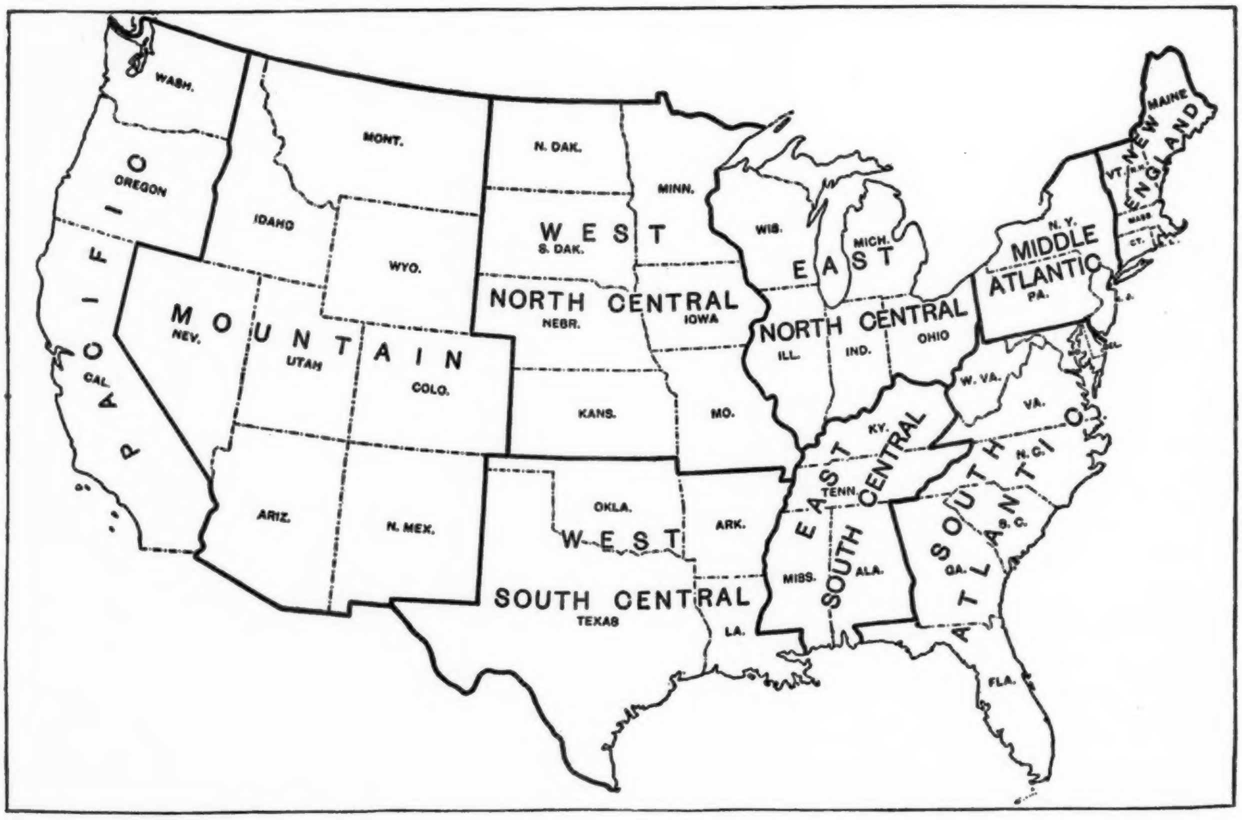
	Area	Cost Per Sq. Yd.
Alabama—		
Birmingham	196,181 b	$2.15
California—		
Los Angeles	397,500	1.90
Connecticut—		
Bridgeport	30,000	2.37
Manchester	7,486 r	1.16
Hartford	128,800	2.91
New Haven	81,000 p	....
New Britain	5,149 x	1.30
Stamford	36,138	1.80
Florida—		
Jacksonville	49,443 a	3.07
Georgia—		
Savannah	5,787	2.40
Illinois—		
Chicago	1,542,733	c 3.96-4.51
Cicero	65,854	2.05 m-3.95
Joliet	33,950	3.20 a
Springfield	18,000	2.70 a
Indiana—		
Fort Wayne	27,296	3.35 b
Gary	63,300 r	1.75
Jeffersonville	5,000	2.65
La Porte	33,384	3.59-3.88
Logansport	20,000 r	....
Valparaiso	6,200	3.25 a
Iowa—		
Clinton	90,000	....
Creston	14,500	1.11 r
Davenport	2,214	2.25 t
Keokuk	45,000	1.51 m
Kansas—		
Lawrence	15,000	1.75 d
Parsons	5,000	1.48 a
Topeka	42,570	2.25
Kentucky—		
Louisville	160,000	2.68 a
Maryland—		
Baltimore	20 mi.	3.50 a
Massachusetts—		
Holyoke	11,178	....
Marlboro	11,705 t	....
Newburyport	9,000	1.50
Worcester	31,889	4.50 a
Michigan—		
Ann Arbor	9,206	2.90 b
Detroit	1,770,500	3.26 e
Flint	375,500	3.32
Hamtramck	12,000	4.50
Highland Park	18,527	2.70 r
Holland	44,000	2.29 a
Jackson	73,450	2.80 a
Kalamazoo	15,706	2.43 d
Lansing	91,112	3.20
Pontiac	79,168	3.32 a
Minnesota—		
St. Paul	44,693	3.50
Mississippi—		
Hattiesburg	16,000	1.27 f
Missouri—		
Maplewood	17,100	1.00 g
Nebraska—		
Alliance	73,500	2.20
Omaha	23,915	2.76 a
New Jersey—		
Bayonne	2,437	2.60 a
Camden	28,267	4.54 a
Jersey City	99,658	2.67 e
Newark	193,708	2.32-3.26
New Brunswick	49,258	4.21 a
Plainfield	5.285	....
So. Orange	18,000	3.50
New York—		
Brooklyn	59.5 mi.	2.35
Buffalo	306,731	4.80 e
Cortland	25,000	2.60
Poughkeepsie	32,913 h	3.25-4.10
Niagara Falls	27,133	4.17 h
Syracuse	262,929	2.80 a
Yonkers	18,978	5.12
North Carolina—		
Durham	25,802	2.70 a
Greensboro	58,290	1.96
Raleigh	3,000	1.28
Wilmington	21,362	2.32
Winston-Salem	94,684	2.29 a
Ohio—		
Akron	6.72 mi.	2.67
Ashland	6,931	1.55 r d
Alliance	6,943	2.75
Ashtabula	41,589	2.57
Bellefontaine	27,640	1.05-1.20 r d
Cleveland	34,451	3.03 a
Columbus	160,752 a	....
East Palestine	18,500	2.45 d
Girard	7,800	2.45 a
Kent	6,800	2.80 a
Lancaster	14,846	2.33 b
Massillon	27,163	2.60
Newark	4,237	1.38 r
Salem	39,919	1.25 r-2.39
Shelby	900	1.54 b
Springfield	6,666	3.25 a
Toledo	213,075	....
Warren	25,318 r	.95-1.05 b
Wooster	21,000	.80 t
Oklahoma—		
Chickasha	6,015	3.10 k
Tulsa	26,655	3.38-3.62
Oregon—		
Eugene	10,900	1.60-1.70
Pennsylvania—		
Allentown	50,000	2.75
Carbondale	6,000	1.67 t
Dickson City	43,000	4.60 h
Jeannette	24,000	1.20 d
Kingston	2,500	3.50 b
Munhall	3,954	1.75 a
Reading	20,000	1.10 r
Scranton	16,575	4.55 a
Sharon	13,240	3.00-3.40 b
Wilkes Barre	36,000	4.65 e
York	43,769	3.14-3.38 h
Rhode Island—		
Providence	80,678	2.25-2.48
South Carolina—		
Charleston	25,241	2.19 a
Orangeburg	23,047	.89 r
Tennessee—		
Knoxville	175,000	1.50-1.90
Vermont—		
Burlington	18,472	1.22-3.50
West Virginia—		
Morgantown	300	1.49 f
Washington—		
Seattle	149	2.40
Wisconsin—		
Fond du Lac	3,705	2.45
Green Bay	76,000	2.30 b
Kenosha	67,108	1.89
Oshkosh	42,812	1.50-2.71
Canada—		
St. John, N. B.	19,219 m	1.75-3.00
Bransford, Ont.	5,711	2.40
Hamilton, Ont.	193,325	2.30
Kitchener, Ont.	10,096	1.25-1.50
London, Ont.	35,000	2.75
Oshawa, Ont.	35,000	3.50
Ottawa, Ont.	88,763	3.40 a
St. Catharines, Ont.	35,000	1.33-1.62
Waterloo, Ont	18,000	2.65 b
Sherbrooke, Que.	9,549	2.20
Verdun, Que.	53,440	3.05 a

Notes: r—resurfacing; x—part on old base; a—1½ inch wearing, 1½ inch binder; b—1½ inch wearing, 1 inch binder; c—1½ inch wearing, 2 inch binder; d—1 inch wearing, 1½ inch binder; e—2 inch wearing, 1½ inch binder; f—1 inch wearing, 1 inch binder; h—2 inch wearing, 1 inch binder; k—2 inch top only; g—3 inch top, 3 inch base; bb—4½ inch black base and 1½ inch sheet asphalt top; m—on macadam base; t—top only, no binder; p—patchwork.

Bituminous Concrete Laid in 1929

	Area	Cost Per Sq. Yd.
Alabama—		
Birmingham	198,931	$2.00 g
Arizona—		
Tucson	92,550	1.55
California—		
Alameda	120,000	.85 m
Alhambra	16,350	1.26-1.30
Brawley	32,511	1.60
Fullerton	5,392	1.17 g
Hayward	7,000	1.80
Long Beach	116,170	1.64
Los Angeles	996,560	1.90
Ontario	45,555	1.35 g
Redwood	38,604	1.80
Richmond	51,540	2.02-2.18
San Francisco	521,161	2.66
San Luis Obispo	1,055	1.80
San Rafael	24,300	2.97
Santa Barbara	26,457	1.62
Santa Clara	3,467	1.62 g
Santa Paula	39,000	1.35-1.43 g
Vallejo	1,067	1,98-2.12
Colorado—		
Colorado Springs	23,628	1.65
Connecticut—		
New Haven	16,000	....
Stamford	5,734	2.00
Florida—		
Jacksonville	11,329	2.65 g
Georgia—		
Brunswick	90,890	2.54 g d
Idaho—		
Boise	20,346	....
Illinois—		
East St. Louis	5,538	3.65
Indiana—		
Fort Wayne	33,338	3.15
Gary	7,900	2.55
Iowa—		
Davenport	2,268	2.54
Kansas—		
Wichita	49,366	2.35
Kentucky—		
Henderson	18,410	2.60
Louisville	75,000	2.42
Louisiana—		
Baton Rouge	1,500	2.70
Massachusetts—		
Fall River	7,019	....
Haverhill	25,500	1.60
Watertown	9,800	....
Minnesota—		
St. Cloud	10,890	2.50
St. Paul	154,708	2.90-3.40
Mississippi—		
Hattiesburg	28,000	....
McComb	45,000	1.61
Meridian	75,000	2.02
Missouri—		
Cape Girardeau	17,253	1.25
Independence	17,398	1.40
Joplin	1,460	1.63 g
St. Joseph	14,032	1.67
Montana—		
Havre	46,800	2.49-2.83
Nebraska—		
Lincoln	25,658	1.94
Nebraska City	16,000	2.08
Omaha	64,080	2.26
Nevada—		
Reno	28,835	2.25
New Jersey—		
Belleville	2,200	3.65
Newark	326	3.67
Somerville	13,635	3.08
New York—		
Brooklyn	7.2 mi.	1.47
Ithaca	25,000	2.00
Niagara Falls	6,719	3.50 e
Richmond (New York City)	129,488	3.22
Rye	12,500	1.70
Syracuse	1,809	2.70
Utica	10,979	2.85
North Carolina—		
Gastonia	27,678	1.77
Greensboro	24,595	1.56
Raleigh	15,000	1.12
North Dakota—		
Fargo	26,100	3.25
Mandan	14,858	2.13
Ohio—		
Cleveland	264,272	2.55
Columbus	92,055	....
Lakewood	26,051	2.60
Oklahoma—		
Tulsa	24,042	2.30-2.90
Oregon—		
Astoria	4,330	1.70
Oregon City	1,000	.90 s
Pendleton	8,000	2.05
Pennsylvania—		
Altoona	45,145	2.10
Media	20,000	....
Munhall	3,426	1.50
Morristown	4,500	1.50 s
South Carolina—		
Greenville	2,000	1.97
Texas—		
Dallas	146,781	2.53
Vermont—		
Burlington	3,069	1.72 g
Rutland	5,000	1.40
Washington—		
Seattle	10,900	1.39
Wisconsin—		
Kenosha	22,779	1.66
Canada—		
Halifax, N. S.	19,600	3.75
Owen Sound, Ont.	20,000	1.50
Trois Rivieres, Que.	166,684	3.40 g
Valleyfield, Que.	25,000	1.20

Notes: t—tar concrete; g—includes grading; m—on old macadam; d—includes drainage; e—includes excavation; s—surface only.



Map of the United States Showing Geographical Divisions Referred to in Article "Public Works Expenditures in 1930"

Bituminous Macadam Laid in 1929

	Area	Cost Per Sq. Yd.
California—		
Alameda	55,000 s r	.23
Alhambra	22,320	.32-.58
Berkeley	13,985	1.44
El Segundo	7,850	.62
Hayward	15,000	1.00
Ontario	11,111	.63
Upland	19,450	.36
Colorado—		
Colorado Springs	6,692	.90
Connecticut—		
Ansonia	3,383	1.50
Bridgeport	50,000	1.55
New Britain	110,000	1.25
New Haven	156,000	....
Stratford	34,320	1.30
Florida—		
Miami	66,795	.50
Georgia—		
Decatur	3,740	1.82
Illinois—		
Evanston	3,688	3.45
Winnetka	2,000	3.00
Kentucky—		
Hopkinsville	31,000	1.00
Maine—		
Portland	18,788	1.50
Massachusetts—		
Brookline	38,000	1.20 to 1.45 g
Brockton	62,700	2.10
Chicopee	20,244	.66 to 1.66
Easthampton	15,170	1.83 to 2.11
Gardner	1.51 miles	3.55 a
Greenfield	34,500	1.61
Holyoke	33,597	....
Lawrence	74,830	2.35
Marlboro	4,400	3.64
Melrose	8,700	....
Milton	21,546 r	.75
Peabody	10,211	2.40
Pittsfield	6,000	.67
Taunton	9,613	2.81
Wakefield	9,000	1.75
Watertown	57,821	....
Webster	3,100	.90
Wellsley	12,000	2.00
Worcester	49,709	2.00
Minnesota—		
Crookston	18,000	.12 s
Mississippi—		
Corinth	20,000	....
Missouri—		
St. Charles	70,000	.50
University City	2,262	4.03 a
New Hampshire—		
Laconia	14,000	2.40
New Jersey—		
Newark	5,475	1.93
Nutley	6,500	1.60
Plainfield	10,977	....
Phillipsburg	5,000	1.75
Prospect Park	3,000	....
West Orange	24,000	1.17 to 1.35
New York—		
Auburn	35,000	1.25
Brooklyn	0.3 mi.	1.85
East Syracuse	31,000	2.80
Elmira	40,000	....
Kingston	62,245	2.40
Ogdensburg	1,500	1.00
Oneida	2,900	....
Portchester	17,000	1.75
Poughkeepsie	2,501	2,12
Richmond (N. Y. City)	59,792	1.83
Scarsdale	37,000	2.00
Tarrytown	800	....
Utica	2,700	....
Yonkers	365,643	1.29
Ohio—		
Akron	0.81 miles	....
Bellefontaine	8,731	.55
Milford	2,666	....
Norwood	492	2.40
Oregon—		
Klamath Falls	150,000	1.00
Pennsylvania—		
Camp Hill	1,400 ft.	1.35
Chambersburg	10,180	.88
Collinsdale	53,186	1.77 to 1.91
Edgewood	2,650	1.75
Elizabethtown	20,000	.45
Lewisburg	11,675	.85
Media	4,000	....
New Cumberland	5,000	1.48 g
Norristown	1,820	1.70
Northampton	1,305	....
Shippensburg	2 miles	2.00
Towanda	5,000	.70
Rhode Island—		
Cranston	10 miles	....
Providence	204,925	1.72
Woonsocket	2,036	....
Texas—		
Ennis	21,200	.50
Vermont—		
Burlington	3,176	2.30
Montpelier	4,500	1.53
Virginia—		
Harrisonburg	20,000	.85
Staunton	10,000	1.00
West Virginia—		
Morgantown	400	1.19
Wisconsin—		
Manitowoc	10,000	....
Portage	1,000	1.30
Canada—		
Nelson, B. C.	5,000	.75
Frederickton, N. B.	9,932	1.44
Ottawa, Ont.	7,111	2.00
Owen Sound, Ont.	4,000	1.10
Joliette, Que.	4,500	1.40
Valleyfield, Que.	.75 miles	3.00

Notes: a—includes all costs; g—includes grading; s—surface only; sr—includes scarifying and regrading.

Concrete Laid in 1929

	Area	Cost Per Sq. Yd.
Alabama—		
Birmingham	136,783	$1.96
Arizona—		
Bisbee	2,500	2.00
Winslow	150	2.80
Arkansas—		
Fort Smith	4,000	2.00
Wynne	66,000	1.89
California—		
Anaheim	550	3.00
Long Beach	127,360	2.56
Los Angeles	2,832,727	2.28
Manteca	22,222	2.25
Napa	3,140	1.79
Orange	7,555	1.98
Oxnard	5,775	1.62
Redland	402	1.80
Redwood	28,702	1.73
San Luis Obispo	3,000	1.98
San Francisco	73,657	2.21
San Mateo	75,930	2.07
San Rafael	8,837	2.37
Santa Barbara	83,850	1.71
Santa Clara	101,100	1.44
South Pasadena	70,000	2.56
Vallejo	2,000	1.80
Ventura	300,000	1.90
Colorado—		
Boulder	1,000	2.00
Pueblo	34,700	1.90
Connecticut—		
Manchester	235	3.50
New Haven	4,000	....
Stamford	7,906	3.60
Florida—		
Jacksonville	45,903	2.25 g c
Tampa	4,575	2.20
Georgia—		
Decatur	1.2 mi.	2.20
Griffin	1,300	1.96
La Grange	50,000	1.80
Macon	12,000	2.00
Savannah	48,985	2.36
Illinois—		
Bloomington	27,292	3.00 a
Chester	19,000	2.12
Chicago	983,799	3.78-4.50
Chicago Heights	50,000	1.89-2.15
Cicero	30,985	3.24 g-4.07 g
DeKalb	45,270	1.71
East St. Louis	79,727	2.96-3.23
Elgin	175,000	1.67-1.80
Evanston	76,968	2.70
Hinckley	2,401	2.01
Hinsdale	50,000	2.20
Lake Forest	11,600	2.80
Mattoon	10,000	2.30
Springfield	17,413	2.98
Urbana	14,108	2.40-2.45
Wheaton	6,150	2.60
Wilmette	34,000	2.36-2.67
Winnetka	5,000	3.00

Public Works Expenditures in 1930

How much do the municipalities expect to spend on public works in 1930, and how does this compare with the amount spent in 1929?

In order to get some definite information on this point, one of the questions asked of city engineers and other public works officials in our February questionnaire was: "Please give, in round numbers, expenditures by your city in 1929 for public works, and expenditures proposed for 1930;" the amounts being itemized under the heads—"Paving," "Sewerage and Drainage," "Water Supply," "Airports," "Public Buildings," and "Other Public Works."

The questionnaire was sent to all municipalities of more than 4,000 population, about 1,850 in all. A few over 900, or just about 50 per cent, had replied when the figures were tabulated; and of these, 400 gave figures for 1930 work as well as for 1929, these being estimated costs of work decided upon, bonds issued for such work, and in some cases the engineer's estimate of what would be done. In making our comparison, no figures for 1929 work were used unless accompanied by those for 1930 for the same class of work in the same city, submitted by the same official. It would therefore seem as though the comparison is as nearly reliable as such figures can be, and that it represents the prospects for work in 1930 in 400 cities, scattered through every state of the country, and typical of the total municipal expenditure for public works of the entire country.

Judging from experience during twenty years of

Concrete Laid in 1929 (Continued)

	Area	Cost Per Sq. Yd.
Indiana—		
Bedford	27,000	2.10
Brazil	3,000	2.75 g
Elkhart	38,600	1.75-2.00
Elwood	1 mi.	....
Fort Wayne	9,100 r	....
Gary	27,200	2.80
Goshen	3,026	2.90
Lafayette	35,178	1.88-2.22 g
La Porte	13,510	2.63-2.95
Logansport	40,000	1.91 g
Mishawaka	66,992	2.25
Munster	12,000	3.30 g d
Peru	880	3.00
Richmond	7,000	2.50
Seymour	4,000	2.30
Shelbyville	4,000	1.85
Terre Haute	54,048	2.00
Valparaiso	12,000	3.00 c
Washington	1,340	2.50 g
Winchester	10,000	....
Iowa—		
Ainsworth	7,000	2.02
Cedar Rapids	6,000	2.25
Charles City	49,000	1.77
Clinton	37,200 r	1.90 g
Cresco	8,958	2.34 c
Creston	11,750	1.73-1.93
Davenport	45,035 r	1.67-1.95
Decorah	25,600 r	2.20-2.32 g
Glenwood	3,500	2.24
Keokuk	12,000	2.27
Newton	4,500	2.55
New Hartford	9,000 r	1.99
Monona	57,000 r	1.87
Ogden	26,470	2.28
Oskaloosa	8,000 r	2.10
Ossian	7,000 r	2.20
Waterloo	17,000	1.78
Vinton	14,000 r	1.99
Wyoming	7,000 r	2.07
Kansas—		
Coffeyville	7,549	2.05
Dodge City	5,200	2.30
Eldorado	6,710	2.31
Emporia	1,000	2.40
Lawrence	12,000	1.91
Newton	16,650	2.09-2.41 g
Parsons	10,000	2.00
Topeka	29,750	1.64-2.22
Wichita	139,284	1.70-1.75
Kentucky—		
Corbin	6,441	....
Dayton	1,200	2.30
Louisville	68,000	1.65-1.80
Maine—		
Augusta	6,123	3.27
Bangor	27,000	2.50
Gardiner	4,925 r	3.54 a
So. Portland	5,600	3.50
Maryland—		
Baltimore	10 mi.	1.90
Massachusetts—		
Brookline	2,318 r	3.42 g
Chicopee	12,216	4.19
Fall River	10,238	....
Gardner	5,502	3.25 g d
Holyoke	17,225	....
Lawrence	8,180	....
Marlboro	7,260	4.82 a
Peabody	1,362	1.79-2.30
Pittsfield	15,740 r	2.45
Taunton	13,593	4.11
Michigan—		
Adrian	12,370	1.95
Alma	1,333	1.98
Ann Arbor	14,000 r	2.19
Battle Creek	50,860	1.81 a
Bay City	18,791	2.90
Detroit	457,705	2.06 g c
Dowagiac	10,000	1.88
Escanaba	11,129	1.14
Grand Haven	10,000	1.68
Hamtramck	11,478	2.20
Hastings	30,931	....
Highland Park	3,197	1.80
Ironwood	10,000	2.80
Jackson	12,850	2.40
Kalamazoo	613	2.38 g
Lansing	7,672	2.75
Owosso	15,475	2.16
Petoskey	10,000	2.10
Pontiac	90,914 r	2.46
Port Huron	25,087	2.30
Royal Oak	61,437 r	3.60
Sault Ste Marie	4,000	2.25
South Haven	2,820	....
Wyandotte	55,600	2.00
Minnesota—		
Chisholm	13,980	1.99
Duluth	138,537	2.29
Mankato	730	2.30
Red Wing	800	2.00 g c
Rochester	600	2.64
St. Paul	114,117	2.40 g
Mississippi—		
Hattiesburg	27,000	1.38
McComb	25,000	1.59
Missouri—		
Boonville	17 blocks	1.70
Cape Girardeau	9,886	1.80
Independence	18,484	2.60
Jefferson City	13,000	2.20
Joplin	33,934	1.65 g
Kirksville	3,500	2.50
Maplewood	27,000	2.43
Marceline	5,600	....
St. Joseph	83,294	2.87
Trenton	6,500	2.35
University City	69,700	3.32 a
Nebraska—		
Fremont	31,621	1.82
Hastings	5,648	1.84-2.69
Lincoln	3,880	1.83
Nebraska City	3,500	2.08
Omaha	32,564	1.42-2.39
Plattsmouth	7,500	1.78
New Hampshire—		
Dover	12,315	2.80
New Jersey—		
Bayonne	1,644	3.30
Belleville	43,637 r	2.49
Bound Brook	2,500	3.15
Camden	36,212	3.39
Flemington	1,300	3.75
Nutley	44,500	2.30-2.50 g
Ridgefield Park	30,000	2.50
So. Orange	20,000	2.90
West Orange	60,000 r	2.40-2.80
New Mexico—		
Deming	1 mi.	2.20
Roswell	125,922	2.17
New York—		
Auburn	39,608 r	2.15
Batavia	19,187	2.75
Buffalo	32,305	5.76 a
Depew	4,500	6.00 a
Geneva	5,000	2.20
Gloversville	13,595	3.92
Jamestown	22,110	2.76
Little Falls	15,893	3.20
Niagara Falls	9,515	3.01 g
North Tonawanda	6,450	2.87
Norwich	1,035	3.76
Ogdensburg	15,247	3.23
Port Chester	50,000	2.80
Poughkeepsie	8,132	3.37
Richmond (New York City)	73,432 r	3.51
Rye	15,000	3.55
Syracuse	2,182	2.70
Utica	46,152	2.42
Watertown	2,407	2.00
North Carolina—		
Durham	2,000	2.50
Greensboro	12,055	1.52
Winston-Salem	27,850	2.00
North Dakota—		
Bismarck	125	3.25
Fargo	1,970	2.77
Grand Forks	51,000	2.29
Mandan	2,378	2.35
Ohio—		
Ada	7,000	1.90
Akron	1.72 mi.	2.57
Ashtabula	5,880 r	2.22
Bucyrus	14,900	2.59
Campbell	49,000	2.30
Cleveland	27,359 r	2.65-2.72
Columbus	37,851	....
East Liverpool	3,500	2.65
Elyria	2,800	2.40
Gibsonburg	5,000	1.97
Kent	939	2.80
Lorain	81,339	3.47
Marietta	4,226	2.40
Massillon	3,943	2.72
Newark	34,016	2.00
Norwood	20,000	2.65
Painesville	35,517	2.84 g c
Salem	2,342	2.55

collecting such data, we believe that cities which did considerable public work are much more likely to return the questionnaire than those which did little; and that the 22 per cent which reported for 1930 did last year, and will do this year, about 40 per cent of the total for all the municipalities. There may, of course, be an error of 10 to 20 per cent in this estimate, but this will in no way affect the ratio between work in 1929 and 1930, and the reported percentages of increase or decrease of 1930 work over that of 1929.

PERCENTAGE INCREASE OR DECREASE IN 1930

Taking the total expenditures of all cities for all classes of work, the reports show an increase this year of 24.6 per cent.

Considering the different classes of work, totals of all cities, we find that *paving* shows no change; *sewerage* and *drainage* an increase of 31 per cent; *water supply* an increase of 16 per cent; *airports* a decrease of 17 per cent; *public buildings* an increase of 468 per cent; and other public works, an increase of 44 per cent.

The increase in public building construction is remarkable. Only six states reported a decrease, and none of the groups of states reported less than 83 per cent increase.

In compiling the figures, the cities were combined by states, and the states in turn by sections of the country, the grouping being that used by the federal government and shown by the accompanying map.

Considering first the totals for all public works, we find an increase for 1930 over 1929 of 10 per cent for New England; 69 per cent for the Middle Atlantic; 87 per cent for the South Atlantic; 176 per cent for the East South Central; 8 per cent for the East North Central; a decrease of 1 per cent for the West North Central (three of the seven states show a slight decrease); an increase of 27 per cent for the West South Central; of 19 per cent for the Mountain; and 9 per cent for the Pacific.

	Area	Cost Per Sq. Yd.
Ohio (Continued)—		
Shelby	6,200	1.97
Sidney	1,130	1.95 g
Springfield	14,879	3.10
Toledo	45,797	2.08
Toronto	1,850	2.75
Warren	8,847 r	1.99
Zanesville	43,650 r	2.60
Oklahoma—		
Ardmore	2,112	2.40
Chickasha	68,310	2.30
Durant	7,000	2.40
Enid	150,000	2.48
Holdenville	12,000	2.25
Muskogee	10,846	2.35
Ponca City	13,580	....
Shawnee	12,000	2.49-2.60
Tulsa	242,480	2.10-2.30
Oregon—		
Astoria	511	2.40
Eugene	33,000	1.90
Klamath Falls	15,000	2.50
Oregon City	3,000	1.80
Salem	124,526	1.81
Pennsylvania—		
Allentown	70,000	2.75
Altoona	121,987	3.00
Bethlehem	62,000	3.25
Clarion	18,000	....
Clearfield	2,300	3.80 a
DuBois	18,508	3.25
Edgewood	3,070	3.00
Ellwood City	7,087	3.28
Greensburg	14,308	....
Jeanette	10,500	2.90
Johnstown	6,850	3.00-3.50
Kingston	8,000	3.00 g
Lansdowne	1,070	2.60
Lansford	16,500	3.20
Lewistown	4,000	3.15
New Brighton	10,695 r	3.22
Norristown	8,000	2.34
Oil City	18,920	2.98
Sayre	2,000	....
Sharon	5,090	2.50
Sunbury	0.8 mi.	3.05
Uniontown	3,282	3.00
Warren	3,286	2.95-3.00
Wilkinsburg	1.71 mi.	3.00
South Carolina—		
Chester	5,946	....
Greenville	14,000	1.81
Greenwood	30,000	1.62
South Dakota—		
Rapid City	19,474	2.03
Tennessee—		
Jackson	12,600	1.91 g
Johnson City	50,000	1.68
Knoxville	135,000	1.35
Texas—		
Austin	155,000	2.08
Bryan	40,000	2.27
Corsicana	30,000	2.09
Dallas	4,108	2.50
Marlin	14,000	1.88
Mineral Wells	50,000	2.00
Wichita Falls	2,000	2.75
Utah—		
Ogden	41,000	1.77
Provo	41,500	2.00
Vermont—		
Burlington	6,395 r	2.96
Montpelier	3,132	3.24
Newport	1,650	....
Rutland	2,000	3.15
Virginia—		
Danville	476	2.00
Newport News	6,700	2.00
Richmond	11,770	1.86
Washington—		
Anacortes	900 ft	....
Everett	.99 mi.	2.00
Olympia	8,000	1.80
Puyallup	9,810	1.75
Seattle	693,935	1.75
Wenatchee	5,520	2.15
West Virginia—		
Charleston	20,927	3.50-3.75 g
Clarksburg	12,300	3.80
Elkins	2,400	2.30
Fairmont	3,690	2.89
Morgantown	1,880	1.95
Wisconsin—		
Antigo	2,350	2.35 g
Appleton	17,000	2.30
Beloit	12,000	1.73
Burlington	10,000	1.77
Eau Claire	8,000	2.80
Fond du Lac	48,828	2.06
Fort Atkinson	11,726	1.55
Green Bay	4,000	2.10
Kaukauna	10,140	3.26 a
Kenosha	17,924	1.80
La Crosse	36,000	2.07-2.54
Lake Geneva	2,067	2.16
Manitowoc	79,000	1.95
Marinette	1,456	2.38
Oshkosh	11,508	2.37 g
Ripon	13,500	1.98
Rhinelander	245	2.36
Sheboygan	117,263	1.90 g
Superior	86,000	1.80-2.50
Waukesha	54,788	1.56
Wisconsin Rapids	40,000	1.87
Canada—		
Nelson, B. C.	2,903	1.97
Bransford, Ont.	1,267	2.40
Guelph, Ont.	17,500	1.96
Hamilton, Ont.	6,920	1.94
Kitchener, Ont.	1,435	2.58 a
St. Catharines, Ont.	12,400	1.95
Sault Ste. Marie	12,954	3.22 a
Stratford, Ont.	8,938	2.70
Sherbrooke, Que.	843	2.15
Trois Rivieres, Que.	101,720	2.19 g

Note: r—reinforced; g—cost includes grading; d—cost includes drainage; c—cost includes curbing; a—cost includes all items.

Gravel, Macadam, Etc., Laid in 1929

	Amount laid	Cost per sq. yd.
California—		
Long Beach	2.11 mi	....
Oxnard	20,000	$0.45
Redlands	82,580 SM	1.10
Santa Maria	20,000	....
Colorado—		
Colorado Spgs.	79,500	.15
Longmont	65,000	.14
Trinidad	7,314 cy	.60
Connecticut—		
Hartford	64,000 MW	1.27
Manchester	27,090 GM	1.00
Middletown	5,401 M	1.00
Stamford	95,000 C	.32
Stratford	30,000 CO	.12
Florida—		
Sanford	19,715 SM	1.06
Tampa	48,214 SM	....
Idaho—		
Nampa	1 mile oil paving	
Indiana—		
Richmond	2,000	.50
Seymour	1,000 cy	1.50
Iowa—		
Charles City	14,000	....
Newton	800	2.67 cy
Kansas—		
Coffeyville	16,260	....
El Dorado	2,000	.15
Parsons	50,000 Ch	.25
Maine—		
Augusta	3 mi	....
Bangor	2,250	.95
Gardiner	4,539 ft	1.36
Maryland—		
Salisbury	40,000 SM	.15
Massachusetts—		
Brockton	158,000	1.39
Chicopee	7,000	.40
Mansfield	10 mi T	.18
Milton	3,700	1.50
Peabody	10,228 A	....
Wakefield	7,000	.70
Webster	444	.80
Wellesley	8,000	.40
Michigan—		
Adrian	2.5 mi	....
Albion	30,000	.50
Alma	5,280	.47
Dowagiac	12,000	1.00
Escanaba	8,000 SM	.15
Flint	15.5 mi	....
Ironwood	30,000	.50
Pontiac	11,200	.44
Port Huron	2,300 C	.45
Three Rivers	5,000	.40
Minnesota—		
Crookston	7,750	.15
Duluth	16,194	.48
Hutchinson	4 blks	....
Mankato	7,750	.15
Montevideo	15,000 T	.12
Virginia	1 mi. T	$5,000

Taking the figures of the different classifications of work, we find the following:

Paving—

In New England, a decrease of 5%.
Middle Atlantic states, an increase of 12%.
South Atlantic states, a decrease of 15%.
East South Central states, an increase of 4%.
East North Central states, a decrease of 4%.
West North Central states, a decrease of 16%.
West South Central states, an increase of 58%.
Mountain states, a decrease of 3%.
Pacific states, a decrease of 1%.

The total expenditure for paving was nearly 60 per cent of all public works expenditures.

Sewerage and Drainage—

New England states, an increase of 12%.
Middle Atlantic states, an increase of 84%.
South Atlantic states, an increase of 53%.
East South Central states, an increase of 494%.
East North Central states, an increase of 9%.
West North Central states, a decrease of 3%.
West South Central states, an increase of 21%.
Mountain states, an increase of 288%.
Pacific states, an increase of 19%.

The total expenditure for sewerage and drainage was 24 per cent of all public works expenditures.

Water Supply—

New England states, a decrease of 9%.
Middle Atlantic states, a decrease of 34%.
South Atlantic states, a decrease of 19%.
East South Central states, an increase of 525%.
East North Central states, an increase of 108%.
West North Central states, and increase of 20%.
West South Central states, an increase of 2%.
Mountain states, a decrease of 30%.
Pacific states, an increase of 21%.

The total expenditure for water supplies was about 8 per cent of all public works expenditures. This does not include expenditures by private water companies.

Airports—

New England states, an increase of 83%.
Middle Atlantic states, a decrease of 52%.
South Atlantic states, an increase of 310%.
East South Central states, an increase of 433%.

	Area	Cost Per Sq. Yd.
Mississippi—		
Canton	5,000	.50
Missouri—		
Booneville	12 mi.	....
Cape Girardeau	1,385	.50
Fulton	16,000 A	.30
Joplin	6,000	.70
Montana—		
Bozeman	7,674	.78
Lewistown	4,935 cy	1.80
New Jersey—		
Flemington	7,500 M	1.40
Freehold	140,000	.33
Newton	12,000	.35
New York—		
Gloversville	3,450	1.99
Oneida	20,400	....
North Carolina—		
Greensboro	6,463 cy	.45
Ohio—		
Lancaster	2,251 M	....
Marietta	10,000	....
Milford	2,000 M	....
New Boston	2,000	.30
Oklahoma—		
Chickasha	9,400	1.28
Muskogee	8,000	.75
Vinita	8,000	1.25
Oregon—		
Oregon City	1,000 M	.70
Pennsylvania—		
Camp Hill	1,600 ft.	.60
Nanty-Glo	2,940 SM	1.18
South Dakota—		
Aberdeen	52,500	.07
Tennessee—		
Jackson	1,000	1.25
Texas—		
Marlin	3.5 mi.	....
Mineral Wells	25,000	.60
Paris	7,800	.50
Waco	25,000	....
Weathersford	10 mi.	....
Wichita Falls	3,500	.37
Utah—		
Ogden	14,500	oiled
Vermont—		
Bennington	2,000 c.y.S.M.	1.50
Burlington	17,750	....
Virginia—		
Charlottesville	15,000	.60
Fredericksburg	25,965 A	.20
Newport News	18,000	.85
Richmond	212,830	.33
Washington—		
Hoquiam	5,000	1.22
Olympia	1,000 c.y.	1.25
Wenatchee	15,000	.45
Wisconsin—		
Edgerton	5,500	.62
Fort Atkinson	12,325	....
Kaukauna	4,800 T	....
Lake Geneva	5,400	1.00
Canada—		
Nelson, B. C.	5,000	....
St. Boniface, Man.	20 mi.	....
Barriè, Ont.	12 mi.	.40
Kitchener, Ont.	9.704	1.25
Stratford, Ont.	5,476 M W	1.53
Cap de La Madeleine, Que.	2,000 C	.40
Chicoutimi, Que.	.75 mi.	.30-.35

Notes: M W—Water bound macadam; S M—Surface treated or oiled macadam; G M—Gravel and macadam; C—Cinder; CO—Oiled cinder; Ch—Chatts; T—Treated with Tarvia or Tar; A—Treated with asphalt; S—Surface treatment.

Brick Pavements Laid in 1929

	Area	Cost Per Sq-Yd.
Alabama—		
Birmingham	25,000	$3.00 g
Arizona—		
Bisbee	500	O.B.
California—		
San Francisco	3,342	3.39
Florida—		
Jacksonville	60,447	3.08 g
Orlando	80,000	2.27
Illinois—		
Cairo	1,000	4.00
Galesburg	52,762	3.25
Springfield	31,150	3.34
Winnetka	1,500	4.20
Indiana—		
Fort Wayne	4,811	4.93
Iowa—		
Creston	31,000	1.82 r-2.80
Davenport	51,260	1.91 O.B.-3.25
Kansas—		
Coffeyville	4,340	2.43
Dodge City	12,000	2.52
Topeka	583	3.64
Michigan—		
Flint	9,879	5.50 a
Kalamazoo	2,023	3.30 a
Minnesota—		
Rochester	21,400	1.56
St. Paul	20,146	3.20-4.70 g
Mississippi—		
Hattiesburg	25,000	2.08
Missouri—		
Joplin	1,375	1.80 g s
St. Joseph	9,894	4.36
Nebraska—		
Lincoln	5,452	2.95
Omaha	9,839	2.43 r
New York—		
Buffalo	3,059	7.18 a
Cortland	600	4.25
Jamestown	58,225	3.67
Lockport	5,577	4.74
Niagara Falls	28,019	3.60 g
Syracuse	16,779 h	5.00
North Carolina—		
Greensboro	2,816	4.81
Ohio—		
Akron	2.77 mi.	3.19
Alliance	8,840	2.90
Cleveland	218,419	3.18-3.68
Columbus	89,176	....
East Liverpool	4,700	3.65
Kent	3,096	3.25
Lakewood	1,340	....
Lancaster	24,292	2.62
Lima	2,818	4.40
Lorain	19,865	2.28
Marion	23,517	2.72-3.57
Massillon	44,673	2.75
New Boston	3,000	3.10
Ravenna	750	3.30 g
Toledo	104,274	3.50
Toronto	2,100	3.65
Warren	6,878	3.47
Wooster	6,630	3.20

	Area	Cost Per Sq. Yd.
Oklahoma—		
Chickasha	1,270	4.05
Ponca City	12,014	2.00 r-3.25
Pennsylvania—		
Duquesne	12,781	4.20
Ellwood City	8,948	3.08
Greenville	16,000	3.25
Jeannette	10,000	2.40
Kingston	1,000	5.00 g
Meadville	15,825	3.65 g
Rankin	2,700	3.90-4.35
Ridgeway	900	....
Sharon	8,720	3.50
Waynesburg	1,000	2.25
Wilkinsburg	6.09 mi.	3.90
Williamsport	14,613	3.30 a
Tennessee—		
Jackson	2,400	3.45 g
Texas—		
Dallas	19,155	3.30
Lubbock	63,750	2.53
Mineral Wells	200,000	2.25
Waco	50,000	2.04
Virginia—		
Richmond	51,992	3.45
Washington—		
Seattle	164	6.25
West Virginia—		
Fairmont	1,980	3.57
Wisconsin—		
Kenosha	1,147	2.96
LaCrosse	100	3.50
Canada—		
Hamilton, Ont.	13,475	2.70

Notes: g—includes grading; O.B.—used old brick; r—resurfacing; a—includes all costs; s—surface only; h—hillside brick used.

Miscellaneous Pavements Laid in 1929

	Area	Cost Per Sq. Yd.
Bitumuls—		
Bisbee, Ariz.	3,335	$0.90
Willite—		
Los Angeles, Calif.	42,280	2.10
National—		
Los Angeles, Calif.	275,900	2.13
Cold Bituminous—		
Berkeley, Calif.	11,500	....
Oxnard, Calif.	800 gal.	
San Rafael, Calif.	4,500	.36
Bristol, Conn.	15,000	1.50
Fernandina, Fla.	55,000	1.84
Macon, Ga.	2,000	....
Lake Forest, Ill.	3,000	3.50
Newton, Kans.	40 tons	
Hamtramck, Mich.	5,400	4.00
Moberly, Mo.	10,000	....
Little Falls, N. Y.	450	1.20
Bellaire, O.	4,000	.90
E. Liverpool, O.	900	1.65
Lorain, O.	2,000 r	.50
Wellsville, O.	8,000	1.75
Medicine Hat, Alta.	2,380	1.17
Kitchener, Ont.	4,834	1.00
Kingston, N. Y.	8,600	....

East North Central states, a decrease of 38%.
West North Central states, a decrease of 57%.
West South Central states, an increase of 1%.
Mountain states, a decrease of 63%.
Pacific states, a decrease of 5%.

Eighty-four cities reported expenditures for airports. The municipal expenditures for these totaled about 3 per cent of all public works expenditures.

Public Buildings—

New England states, an increase of 143%.
Middle Atlantic states, an increase of 734%.
South Atlantic states, an increase of 495%.
East South Central states, an increase of 94%.
East North Central states, an increase of 610%.
West North Central states, an increase of 121%.
West South Central states, an increase of 157%.
Mountain states, an increase of 914%.
Pacific states, an increase of 83%.

The total municipal expenditure for public buildings was about 3 per cent of all public works expenditures.

Other Public Works—

New England states, a decrease of 5%.
Middle Atlantic states, an increase of 4%.
South Atlantic states, an increase of 1,370%.
East South Central, none reported.
East North Central states, an increase of 273%.
West North Central states, an increase of 1%.
West South Central states, an increase of 38%.
Mountain states, a decrease of 25%.
Pacific states, an increase of 15%.

The total municipal expenditure for "other public

	Area	Cost Per Sq. Yd.
Amiesite—		
Wilmington, Del....	51,600	3.25
Mattoon, Ill.........	20,000	2.00
Peru, Ind...........	3,800	2.79
Frostburg, Md......	3,000	3.38
Holyoke, Mass.......	1,307	....
Elmira, N. Y.......	1,500	....
Niagara Falls, N. Y.	7,238	3.90
Kent, O............	5,337	3.00
Providence, R. I....	1,293	2.03
Richmond, Va......	2,587	1.58
Charleston, W. Va..	3,823	2.52
Woodstock, Ont.....	33,080	1.98
Chicoutini, Que......	1.25 mi.	2.00
Geneva, N. Y......	6,000	2.60
Glenns Falls, N. Y..	21,209	....
Warrenite-Bitulithic—		
Winslow, Ariz.	6,500	2.75
Los Angeles, Calif...	55,226	2.22
Lewiston, Ida.......	87,000	1.77-2.03
Bridgeport, Conn. ..	11,160	3.45
Clinton, Ia.	10,300	2.40
Portland, Me.	17,064	4.11
Brookline, Mass. ...	25,900	3.22
Joplin, Mo.	11,725	1.95
Buffalo, N. Y.......	33,739	4.10
Lockport, N. Y......	2,000	4.80
Utica, N. Y.........	79,550	3.15
Yonkers, N. Y......	11,043	4.15
LaGrande, Oreg. ...	1,245	2.40
Johnstown, Pa.	12,993	4.10
Richmond, Va.	60,046	2.45
Peterborough, Ont...	43,112	2.97
Rock Asphalt—		
Sheffield, Alabama..	10,000	1.61
Fort Smith, Ark....	5,000 C	3.00
West Helena, Ark...	9,056	2.21
Santa Maria, Calif..	60,000	1.35
Middletown, Conn...	27,951	2.17
Miami, Fla.........	4,521	2.28
Cairo, Ill.	85,395	.72
Lake Forest, Ill.....	3,200	1.75
Crawfordsville, Ind..	2 mi.	1.25
Richmond, Ind......	20,000	2.40
Danville, Ky........	3,972	2.45
Hopkinsville, Ky....	600	1.75
Louisville, Ky.......	16,000	2.50
Sanford, Me.	....	5,000
Greenfield, Mass.....	2,974	2.50
Battle Creek, Mich..	9 cars	....
Niles, Mich.	3,000	.85 r
Canton, Miss.	14,000	1.40
Hattiesburg, Miss...	6,000	1.85
Jackson, Miss.	250 tons	....
Durham, N. C.......	1,000	.50 s
Delaware, O.	1,600	1.08
Gibsonburg, O......	8,315	1.15
Marietta, O.	25,000	1.08
Greensburg, Pa......	12,274	1.35
New Brighton, Pa...	6,000	1.23
Providence, R. I.....	444	2.57
Johnson City, Tenn..	1 car	....
Austin, Tex.	0.75 mi.	....
Cisco, Tex.	4,037	2.04
Dallas, Tex.	69,798	2.53
Denton, Tex.	63,400	2.20
Laredo, Tex.	83,500	2.20
Paris, Tex.	1,800	2.80
Waco, Tex.	5,600	2.25
Wichita Falls, Tex..	9,200 r	.52
Newport, Vt.	888	1.54
Danville, Va.	320	2.75
Charleston, W. Va..	8,555	3.65 g
Superior, Wisc.	1,473	2.22
Glace Bay, N. S....	27,700	2.65
Asphalt Block—		
Tampa, Fla.	155,771	2.30
Rye, N. Y..........	2,600	4.50
Toledo, O.	26,449	4.00
Asbestphalt—		
Brookline, Mass.....	4,613	1.50
Granite or Rurax Block—		
Portland, Me.	10,726	4.34
So. Portland, Me....	4,000	4.05
Fall River, Mass....	1,515	....
Lawrence, Mass. ...	7,158	....
Newark, N. J.......	919	8.60
Brooklyn, N. Y.....	4.9 mi.	5.85
Richmond, N. Y.....	30,966	6.63
Yonkers, N. Y.....	10,603	6.70
Greensboro, N. C....	7,136	4.84
Winston-Salem, N.C.	9,012	4.15
Toledo, O.	38,320	4.45
Edgewood, Pa.	298	5.25
Greensburg, Pa.	435	....
Scranton, Pa.	1,177	7.15 a
Providence, R. I.....	17,656	8.25
St. John, N. B......	2,255	6.47
Ottawa, Ont.	3,349	7.00
Sherbrooke, Que. ...	459	4.80
Vibrolithic—		
McComb, Miss.	30,000	2.04
Fargo, N. D........	15,400	3.01
Elyria, O.	13,470	2.45
Torrington, Wyo. ..	14,800	2.24
Stanolithic—		
Buffalo, N. Y.......	37,028	4.29
No. Tonawanda, N.Y.	2,800	....

Notes: C—by County; r—resurfacing; s—surface only; a—includes all costs.

works" was about 3½ per cent of all public works expenditures.

ESTIMATED TOTAL EXPENDITURES

On the basis of considerations mentioned above, it is assumed that the totals of expenditures for these 400 cities represent about 40 per cent of the total expendiures by all municipalities of more than 4,000 population. (This includes no expenditures by counties, states or federal government for highways, bridges or other public works.) Our totals have therefore been multiplied by 2½ to give such estimated actual totals. Expenditures by municipalities of less than 4,000 population, of which there are many hundred, total to considerable sums but these have been omitted from our calculation, which tends to make them even more conservative.

In addition, there are considerable sums spent by private water companies, light and power, gas and other public utilities, which will be referred to further on.

Municipal expenditures estimated on the above basis (to the nearest million dollars) are as follows:

Totals for the Entire Country—

All classes of work combined: $386,000,000 in 1929; $481,000,000 in 1930.

Paving—$225,000,000 in 1929; $226,000,000 in 1930.

Sewerage and Drainage—$92,000,000 in 1929; $121,000,000 in 1930.

Water Supply—$32,000,000 in 1929; $37,000,000 in 1930.

Airports—$11,000,000 in 1929; $9,000,000 in 1930.

Public Buildings—$12,000,000 in 1929; $68,000,000 in 1930.

Other Public Work—$13,000,000 in 1929; $19,000,000 in 1930.

About one-third of the municipal water supplies of the country are privately owned. These include few if any of the supplies of the very large cities, and it may be estimated that their expenditures amount to one-fourth as much as those of municipal plants, or nearly $10,000,000 in 1930.

Probably at least another $10,000,000 will be spent for wire conduits, mains and other structures by lighting, gas and other utility corporations. This would bring the total expenditures on municipal public works in 1930 to a total of over $500,000,000.

Progress in Completion of Federal Aid Roads

Public Works;

Gentlemen:—

I note in a recent issue of "Public Works" an editorial states that 95 per cent of the Federal Aid System of Highways in the United States is either completed or under construction.

I am quite sure your information on this point is in error. At the present time the Federal Aid Highways System is composed of a little over 189,500 miles. The last annual report of the Bureau of Public Roads shows that this system has been improved with Federal funds to the extent of 78,063 miles, in addition to that they have placed under contract a sufficient mileage to increase the total, when completed, to a little over 90,000 miles. In the meantime the States have improved on this Federal Aid System almost 81,000 miles. But it should be noted that in calling this work "completed," fully 15 per cent is simply graded and drained ready for some kind of surfacing.

In view of this situation, you can readily see that the Federal Aid System of Highways in the United States is not 95 per cent completed or under construction.

Very sincerely,

W. C. MARKHAM, Executive Secretary,
Am. Ass'n of State Highway Officials.

The statement made was that "Ninety-five per cent of the mileage approved for Federal Aid by the Bureau of Public Roads is completed or nearing completion." We should have said "approved *for construction* by Federal Aid," which statement would agree with the figures issued a few months ago by the Bureau of Public Roads. As Mr. Markham says, there is still a large part of the mileage apportioned to the different states for Federal aid which has not yet been approved for construction, but probably will be in time as Federal funds become available and the states apply for same.

We are glad to learn the figures given by Mr. Markham. The Bureau of Public Roads gives the mileage "completed" and "under construction" as of December 23, 1929, at 82,330 and 8,735 respectively; a total of 91,065 miles.

Man and Team vs. Power Equipment

By J. J. Idzorek*

Recalling past methods, the writer sees wonderful strides made in patroling and maintaining roads. In 1924 we were using horse-drawn equipment to maintain our roads, which was to some extent satisfactory in keeping them in rideable condition. But as traffic increased, better maintenance was demanded increasingly until the cost of it was becoming prohibitive.

In January, 1928, Redwood county had 39 men and 38 teams maintaining its system of 213.3 miles of gravelled roads. Something had to be done to keep down the maintenance expense, and we decided to adopt power equipment. We purchased five 10-20 McCormick-Deering tractors and Stockland Whippet graders, and a Caterpillar "30" with a Regan grader. Each patrol unit replaced 4 men and 4.66 teams, leaving us with a maintenance personnel of 16 men and 10 teams to cover, at that time, 214.3 miles of road.

This system proved so satisfactory that we have reduced our maintenance cost approximately $39 per mile, and our roads have been maintained more satisfactorily and so uniformly that it is a pleasure to ride over them and not be able to tell where one maintenance man stops and the next starts.

Below are comparative figures of maintenance costs from 1924 to 1930:

Year	Miles Maintained	Total Cost of Maintenance	Ave. Cost per Mile	Kind
1924	201.6	$29,988.75	$148.75	Man & teams
1925	207.5	34,588.22	166.69	Man & teams
1926	211.3	35,738.69	169.14	Man & teams
1927	213.3	39,931.39	187.21	Man & teams
1928	214.3	29,371.47	137.06	Power patrol
1929	216.3	26,141.71	120.86	Power patrol

The average cost of man and team during the first four years was $167.95 per mile; and of the power patrol during the last two years, $128.96; a reduction of $38.99 per mile.

The cost of operation, including gas, oil, alcohol, grease, repairs, replacements, labor, and depreciation, has been $1.46 per hour. As a patrol supplants 4 men and 4.66 teams, which involve a cost of $2.33 per hour without depreciation, six patrols save us $52.20 per 10-hour day.

*County engineer and superintendent, Redwood Co., Minn.

Cost of Operating Patrols

Patrol No.	Hours Worked	Total Cost	Depreciation	Ave. Cost per Hour
1	1881	$2134.93	$1309	$1.831
2	1953	2174.53	892	1.5705
3	2083½	2403.38	500	1.3935
4	2296	2339.72	430	1.207
5	2562	2983.06	430	1.332
6	2333½	2645.90	430	1.3184

Average cost per hour for six patrols, $1.442

In addition to reducing the cost of maintenance, the power patrol has the additional advantage of convenience for removing snow, improving the riding condition of the road, and providing us with a personnel that is enthusiastic over the results obtained.

Cross-Connections in Chicago

During the year of 1928, 874 premises in the city of Chicago were inspected for cross-connections with city water pipes. Many of these were learned of through complaints of consumers that the city water had a bad taste or odor or was not clear. Cross-connections were found between the city mains and river, foul wells, cooling towers, elevator pits, lime vats, salt brine vats, condensers, etc.; also city water pipes submerged in foul water vats, in instrument sterilizers, dish washers and other containers of polluted water. In the latter cases, should the water company find it necessary to close a street valve at any time, the water from the tank is apt to flow back into the city main.

A peculiar type of cross connection was found through a complaint that blue water was coming to several buildings from the same water main. Investigation proved that the condition was caused by a leak in a condenser tube of an ammonia cooler in a nearby ice plant, which allowed an hydrous ammonia gas to be forced into the city water main to which the cooler was directly connected. A sample of the blue water when analyzed showed that it contained 1.76 grams of ammonia per hundred cc. and .00352 gram of copper. The blue color of the water was probably due to the presence of copper which was dissolved by the passage of the strong ammonia solution through bronze valves and fittings. A survey was made of the ice plants throughout the city and a majority of these were found to have cross-connections with the city water similar to the one described, and such connections were ordered discontinued. In these plants the city water is used in an outer pipe or shell to enclose and cool the piped chemicals within. A leak in the chemical pipe would introduce the ammonia or other chemicals into the water, and as these chemicals are under a pressure greater than the city pressure they would be forced into the city mains through the connection.

Photo by J. E. Haring

A Crooked Bridge

The crooked bridge shown in the accompanying illustration is located on Virginia Route 51, a broad, high-speed gravel highway, about 15 miles south of Spottsylvania. Too narrow for cars to pass, its danger to the traveling public is greatly increased by the fact that both approaches are masked by curves and sharp down grades. The battered rail is evidence of the results of this combination of dangerous conditions. No records have been kept of the number of accidents on this bridge, but we respectfully enter it as a contender for whatever honors such a record would claim.

The Editor's Page

Municipal Expenditures for Public Works in 1930 Will Exceed Those of 1929 by 25 Percent

Business in our line—that of public works—will be better in 1930 than it was in 1929.

There is nothing new or startling in such a statement; in fact, thousands of similar statements have, during the past two or three months, appeared so frequently in so many places as to give the impression of a concerted application of the principle of mass psychology that if you can only get enough people to think a thing is so, it *will* be so.

But few if any of these prophecies are backed by supporting evidence—they are merely the expressed opinions of more or less prominent merchants, bankers or politicians, based often, we imagine, on hope rather than facts.

But Public Works offers something new along this line—tangible facts and exact figures, thousands of them, as a basis for the statement that there is little doubt that more money will be spent by municipalities for public works this year than last.

Within the past month it has received nearly one thousand replies to a questionnaire sent to the city engineer or other public works official of each of the more than eighteen hundred municipalities having at least four thousand population. These told the amounts spent by the municipalities last year on paving, sewerage, water supply, airports, public buildings and all other public works. What is far more important, four hundred of these engineers were able to tell quite approximately what would be spent this year on each of these classes of work. Their statements were based upon municipal budgets, bond issues authorized, or projects which the public works officials have been directed to carry out and for which contracts have been let or estimates of cost made. In a few cases the engineers based their figures on opinions only—generally that the amount of work done would be the same as last year, or that there would be none at all; but even in such cases, their abilities to estimate are based on more definite knowledge than that available in estimates for most other classes of business, and the number and nature of such estimates received are such as not to materially affect the result.

In using these figures to compare probable expenditures in 1930 with those made in 1929, we have been careful to use only strictly comparable figures. No figure for either year was used unless accompanied by a corresponding figure for the other year, for the same class of work, in the same city, and furnished by the same official.

We have gone into this matter at some length in order to convince our readers of the reliability of the figures and the deductions therefrom given elsewhere in this issue.

In brief, these indicate that municipalities spent $400,000,000 on public works last year and will spend $500,000,000 this year. The amount spent for paving will be about the same: for sewerage, 31 per cent greater; for water supply, 16 per cent greater, and for other public works, 164 per cent greater.

Grouping the states in the geographic divisions employed by the federal government, we find that New England cities expect to spend 10 per cent more for public works this year than last; those of the Middle Atlantic states 69 per cent; of the South Atlantic 87 per cent; of the East South Central states 176 per cent; of the East North Central states 8 per cent: of the West South Central states 27 per cent: of the Mountain states 19 per cent: and of the Pacific states 9 per cent. Expenditures by the cities of the West North Central states will be about the same—the figures show a decrease of one per cent.

Those interested (and what public official or contractor is not?) will find figures in more detail in the article on pages 112 to 116 of this issue.

Experimental Sewage Treatment Plants at State Institutions

Sewage treatment plants connected with state institutions should be models for all other plants in the state in excellence of design and efficiency of operation. But too many of such plants are a disgrace rather than a credit to their state. On the other hand, it is to the credit of some health boards that they make every effort and employ all their authority and persuasion to bring and keep these institutional plants up to the maximum efficiency of up-to-date practice. Probably only state health officials can appreciate the apathy and political and financial obstacles which they have to overcome in securing such results.

It seems to us that these institutional plants present opportunities as well as difficulties. The Massachusetts State Board of Health began, nearly fifty years ago, carrying on experiments in sewage treatment which made it world-famous, using plants constructed on a very small scale; and several other state health boards have carried on small-scale experiments, often in the laboratories of colleges with which their officials were connected. But other investigators, like those of Milwaukee, have realized the greater reliability of experiments made with full-size operating plants and have spent large sums in building and operating such. The New Jersey Experiment Station has been fortunate in securing the cooperation of the Plainfield disposal plant in carrying on its studies.

Why should not state sanitary engineers be given full control of all sewage treatment plants at state institutions, not only with a view to making them models for the instruction and encouragement of operators of other plants in the state, but also with power to employ them as experimental plants? Here they would have full-size plants in actual service, with power to change such details of construction and operation as might, from time to time, seem desirable for their studies and investigations, and at no cost except for such structural changes as might be made. In many cases even this cost might be kept down and operating costs reduced by using inmates of the institution for labor. These plants could be used also for training plant operators. In fact, there would seem to be many advantages in such a plan.

Mechanical Distribution of Larvicide for Mosquito Control

Some of the more recent methods and equipment for applying oil and dust used for this purpose

By H. A. Johnson

Malaria has been increasing to a rather alarming degree in the last three years, except where proper measures have been taken for its control. Malaria is probably the greatest single handicap to the proper industrial and economic development of any community or section where it is seriously prevalent. That it can be controlled, eradicated, built out of a section is a matter of common knowledge. The methods and the results obtainable are known definitely.

There are two distinct varieties of mosquito larvae in the United States—those that feed below the surface, and those that feed at the surface. The malaria-conveying mosquitoes of the South are produced by the surface-feeding larvae, and these are, therefore, of extreme importance from a public health standpoint.

Oil has long been used to suffocate and kill the larvae of all types of mosquitoes and it still holds its place in general mosquito control work. The surface-feeding larvae, however, of the malaria-conveying mosquitoes can be destroyed most economically by spreading on the water surface a poison dust which apparently is ingested as food. Any larvicide, to be effective, must be applied at not greater than ten-day intervals.

Above: Oiling by means of a hand pump

At right: Evinrude high - pressure pumper in anti - mosquito work

Below: Air pressure system of oiling. Pictures courtesy of the Alabama Power Co.

It is not the purpose of this paper to dwell at length on the various oils and dusts available for anti-mosquito work but rather to describe some of the more recent methods of applying these larvicides whereby the cost of mosquito control has been materially lessened.

The Alabama Power Co. is a leader in anti-mosquito control work and on its impounded lakes its supervisor of sanitation uses three methods of spraying oils from a boat. In one method three intercommunicating horizontal tanks, similar to the familiar hot water tank of the home, are placed in a skiff. Two of these are oil containers while the third is filled with air at high pressure. A reducing valve maintains about thirty pounds pressure on top of the oil. With this device a fine spray can be thrown farther than by hand spraying and large areas covered at a more rapid rate.

Another device consists of a skiff carrying a fifty-gallon oil drum and an Evinrude twin-cylinder high-pressure pumper, model DDV.* This gasoline-driven pumper throws a 75-foot to 100-foot stream of lake water acting as a carrier for the oil, which is fed into the pump suction as desired. Oil placed in this manner is said to be very effective in vegetation and large, difficult areas are handled with remarkable speed. As the pumper weighs only 105 lbs., it is well adapted to be carried on a truck or Ford car and be used for roadside ditches, borrow pits, isolated pools, etc. This pumper is extremely portable and has not yet been developed to its utmost for mosquito work.

Under some conditions a hand-operated horizontal plunger pump has been used from a boat for oil spraying and gives very satisfactory results.

All boats carrying these sprayers are powered with high-speed Johnson outboard motors, which enable them to operate efficiently five miles or more out from a loading plant.

In the DesPlaines Valley mosquito abatement work in Illinois the "Oil under air pressure" system has been used in connection with motorcycles for the oiling

*The Evinrude Co., Milwaukee, Wis.

of catch basins. Suitable-sized cylinders of oil under air pressure are carried in a box side car, and the motorcycle operator, driving up to a catch-basin, sprays one half pint of oil into it. It is said an average of 800 catch basins per day are treated in this manner. Air under pressure is obtained from any filling station.

Ford trucks have an important place in the collection and handling of oil larvicides and in one place, at least, they are being used directly for oil application. In the New Jersey salt marsh mosquito work, wide wheels are provided and a power take-off pump is installed in trucks which traverse the marshes and distribute oil in parts inaccessible by other means.

Although the high toxicity of paris green against the top-feeding larvae of the disease-conveying mosquitoes has been known since 1921, it is only within the last three or four years that mechanical methods have been devised for its application. At first 1% paris green by weight was mixed with 99% inert road dust, but while this was very satisfactory close at hand it would not kill at any great distance. As developed and used today, hydrated lime is used as a diluent and carrier and a paris green strength of 5% to 15% is employed. With such strengths, distances up to 600 feet away can be treated effectively.

The airplane was used in the first successful dusting work, and at Quantico, Va., immense areas of waters producing disease mosquitos were dusted at an extremely low unit cost. More than that, it was the first really successful anopheles control work around that important naval station.

For the dusting of large bodies of water from boats, the Bean† and Niagara§ gasoline engine-driven orchard dusters have proved satisfactory. One hydro-electric company uses a Niagara F2§ duster in a boat and drives the machine with a 4hp gasoline engine. This unit has materially reduced anopheles control costs for that company. The Bean duster can be similarly employed and has an advantage, perhaps, in that it mixes the dust as well.

A highly portable and satisfactory power duster is that developed by the U. S. Public Health Service and described in the September, 1929, issue of PUBLIC WORKS. It consists of a Homelite* generator operating a Sturtevant "Big Midget"‡ electrically driven hand blower. The complete outfit weighs about 115 pounds and can be used from a boat or truck. It has the further advantage that the blower can be operated at a distance from the generator limited only by the length of electric cable available.

Within the past year the hand-power cotton dusters, such as the Niagara, Savage,§ Root, and Feeny,‡

†The John Bean Mfg. Co., Lansing, Mich.
§Niagara Sprayer Co., Middleport, N. Y.
*Homelite Corp., Port Chester, N. Y.
‡B. F. Sturtevant Co., Hyde Park, Boston, Mass.

§D. B. Smith & Co., Utica, N. Y.
‡Feeny Mfg. Co., Muncie, Ind.

The Bean Dust Mixer

Motorcycle used in catch-basin mosquito control work

Above: Dusting Overgrown Ditches. Oil would be practically useless here on account of vegetation

Below: Equipped for Dusting. The respirator is used only during the mixing of the dust

Dusting Unit Developed by the United States Public Health Service

have proved very satisfactory for dusting work. These hand blowers will give complete mortality among surface feeding larvae up to 250 feet from the point of liberation.

The paris green dust larvicide, where it can be used (against top feeding larvae), is the most economical and satisfactory larvicide yet made available. Dense growths and water plants offer no barrier to successful dusting; the dusts are relatively inexpensive; taking advantage of the wind, it can be applied from considerable distances; it has never been shown to be toxic to any form of life except anopheles (surface feeding) larvae, and it is not disagreeable to handle and apply.

Large quantities of this larvicide can be mixed by hand, but in extensive campaigns mixing by machine is much more economical. The John Bean Manfg. Co., of Lansing, Mich., manufactures a gasoline engine-driven dust mixer with which one man can mix enough dust in one half hour to supply 15 dusters for a full day.

Gas Pressure Bursts Sludge Pump

An article was published under the above title in our February issue, in connection with which there was a table showing the character of sludge digested under pressure in steel container. The author, Mr. Keefer, has called our attention to the fact that in about the middle of this table opposite the heading "Incubation temperature," are given the figures 59.80 and 57.86. These should have been 59-80 and 57-86. We are very sorry that this error escaped the notice of our proof reader.

Correcting Corrosive Water at Institution[1]

Intense corrosion of both cold and hot water pipes, due to carbon dioxide acidity, corrected by introducing lime at the well.

By G. M. Ridenour[2]

An interesting typical example of intensive acid water corrosion was recently encountered at one of the large New Jersey State Institutions located at Vineland, New Jersey.

The situation was exceedingly serious and expensive to the institution. Corrosion occurred in both hot and cold water mains and pipes, with special severity in the hot water pipes and steam heating lines. It was necessary to replace continuously parts of the hot water lines and steam carrying system. Corrosion was especially severe at pipe joints and radiator connections. The interior decorating of the various buildings was constantly ruined by leaky overhead pipes. Red water was very troublesome in all parts of the water system.

WATER SUPPLY

The water supply is drawn from a well 260 feet deep. The first 180 feet formation is of yellow sand followed by clay and sand, coarse sand and finally blue sand and clay. The screens are located in coarse sand.

1. Journal Series paper of the New Jersey Agricultural Experiment Station, Department of Sewage Disposal.
2. Research Engineer, Dept. Sewage Disposal.

Geographically, the well is located in a low, sandy, section of the Coastal Plain. This section adjoins large areas of marsh lands.

Analysis—The water, analyzed from a sample taken at the source, was low in pH (5.5) and fairly high in free carbon dioxide acidity (14.0 p.p.m.). No mineral acidity was detected. In addition, the total alkalinity, all as bicarbonate, was only 10 p.p.m. No sulfates or chlorides existed. Dissolved oxygen ran 2.0 p.p.m.; hardness 22 p.p.m. No iron was detected at the source. The actual results of field analysis of the well water at the source are shown in the table.

The analysis of the water from the consumers' tap was almost identical with the water at the source, with an exception of 4.9 p.p.m. ferric iron content.

CORRECTING CORROSIVENESS

A commercial vacuum type of deaerator had been installed by the institution to remedy the situation by removing destructive dissolved gases. But although the acidity of the water was by this means reduced from 14 p.p.m. to 2.0-4.0 p.p.m. by removing the free carbon dioxide, and the pH raised from 5.5 to 6.2, the corrosive action of the water continued.

The failure of the deaerator to remedy the situation is attributed to the original low natural alkalinity of the water which if present might assist in bringing the pH up to a desirable alkaline range with the same removal of acid forming gases.

Lime Treatment—The treatment that suggested itself for the correction of this acid water condition was the application of lime to the water at the well source, for a twofold purpose: First, to neutralize the acidity of the water and create an alkaline condition; and second, to establish a relation between carbonate, bicarbonate and free carbon dioxide so that a slight carbonate coating would be formed and maintained on the pipe lining to prevent access of oxygen or acids to the pipe metal. The Van Heuser marble test was used to indicate this point of equilibrium.

Since in this case it was necessary to introduce the lime into the pump suction, a special home-made device was necessary to avoid entrainment of air in the pump suction. This consisted essentially of a Savage dry feed machine, and a home made float-control equalizing chamber to maintain at all times a constant water level in the dry feed baffle chamber, regardless of fluctuations in the pump discharge.

Since the application of lime precedes the storage tank, any foreign material in the lime or excess lime is settled out at that point. The storage tank is blown off at intervals to remove any such deposit.

Operation—Upon starting the apparatus, sufficient lime was introduced to bring the pH of the treated water to 7.7. This point had been determined previously by means of the Von Heyer marble test as being the optimum for the desired carbonate, bicarbonate and free carbon dioxide balance. Although it was difficult to obtain a consistent test on samples taken at the discharge side of the pump, due to fluctuations in the discharge, the storage tank served as a mixing and equalizing basin so that samples taken from the system were fairly constant in value, ranging from 7.7 to 8.0. From three to five pH determinations are made daily by the operator to check on the application.

RESULTS

By maintaining the pH in the distribution system between 7.7 and 8.0 the free carbon dioxide acidity was reduced to a value varying between 0 and .2 p.p.m. Bicarbonate alkalinity increased to about 43 p.p.m. Carbonate alkalinity is occasionally present and ranges from 0 to 8 p.p.m.

The deaerated water which serves as the source of hot water for the main buildings of the institution, including the laundry, runs generally higher in pH (8.3). The total alkalinity ranges between 48 and 52 p.p.m. Carbonate alkalinity is occasionally detected in the water up to 4 or 5 p.p.m.

Shortly after operation was commenced, the amount of lime applied was accidentally increased to an excessive amount for a few days with a subsequent heavy carbonate deposit which caused stoppages of a great many of the water inlet valves on the commodes and hearty complaints from the institutional laundry about the hardness of the water. To remedy this trouble, the application of lime was discontinued for about two days. The stoppages immediately cleared up, and though the adjusted amount of lime maintained the hardness of the water between 50 and 54 p.p.m. no further complaints were received from the laundry.

Within one month and a half after the lime treatment was instituted, there was very noticeable improvement in conditions. Troubles with leaky pipes had stopped and red water disappeared almost entirely, with the exception of a few dead-end pipes.

Cost—The cost of the installation was approximately $400. Lime consumed averages about 30 pounds per hundred thousand gallons of water.

Saving—In addition to the elimination of a great inconvenience, a labor time saving equivalent to two full-time men will be effected, plus the cost of materials replaced. This estimate was given by the plumber at the institution as being the equivalent amount of time previously spent on repairing leaky pipes.

All work pertaining to New Jersey institutional water and sewage problems is being carried out through a cooperative arrangement between the State Department of Institutions and Agencies, of which Mr. Ellis is commissioner, and Mr. Leathem, director and the Department of Water Supplies and Sewage Disposal of the New Jersey Agricultural Experiment Station.

Certification of Water Supplies for Public Carriers

The Surgeon General of the United States Public Health Service has issued the following ruling:

Hereafter water supplies used by interstate carriers for drinking and culinary purposes will not be given a full certification if cross connections exist between that supply and any other supply; except, when such cross connection is with another potable public supply or a potable supply regularly examined by those in charge of the supply to which cross connected; and except, further, when such cross connections are equipped with modern protective devices approved by the State Department of Health and installed and operated under the direct control of that Department. Auxiliary intakes and by-passes are considered as cross connections.

Analyses of water before and after treatment

	Well water at source		Consumers' tap (cold water)		Deaerated water (hot water)	
	Before	After	Before	After	Before	After
	(1) ppm.	(2) ppm.	(3) ppm.	(4) ppm.	(5) ppm.	(6) ppm.
pH	5.5	7.7-8.0	5.5	7.7-8.0	6.0-6.2	8.3
Total acidity	15.0	0-2.0	15.0	0-1.5	2.2-4.0	0
Carbon dioxide acidity	14.0	0-2	14.0	0-1.4	2.1-4.0	0
Mineral acidity	0	0	0	0	0	0
Bicarbonate alkalinity	10	47-52	10.0	47-52	9.0	46-50
Carbonate alkalinity	0	0	0	0	0	0-5
Hydroxide alkalinity	0	0-4	0	0-4	0	0
Hardness	22	54-58	20.0	55-58	9.0	54
Oxygen	2.0	2.1	1.9	2.1	2.2	1.3
Ferric iron	0	0	4.9	0.1	—	—

Steam Generation by Miami's Incinerator

Miami, Florida, being in a warm climate has a number of variations of the refuse disposal problem which are not found in northern climates. For instance, there being no stoves for heating in that city, and cooking generally being done by electric ranges or kerosene stoves, the people have no way of destroying their own rubbish except burning it in the yard, and that is prohibited except under special permits from the fire department and is discouraged. Therefore, the amount of rubbish to be handled is large, and the large amount of scrap building lumber, paper, etc. gives it a high heating value; while the weight is only about 164 pounds per cubic yard. During the year 1929 the incinerator handled 61,000 tons of refuse from a population of possibly 140,000.

The incinerator plant consists of seven Nye units of two furnaces each, which handle about 61,000 tons of refuse per year. The fourteen furnaces comprising the incinerator plant are arranged in a semicircle, to the centre of which an inclined roadway brings the trucks. After weighing, the trucks are backed into the charging floor of any one of the fourteen furnaces and unloaded by means of a bed chain, the use of which obviates all dumping mechanism. (Incidentally, the absence of dumping mechanism on the trucks lowers the loading height of the truck about seven inches.) The fuel is pushed into the furnace by means of a bulldozer, consisting of a small tractor equipped with a pusher blade. The plant was built by the Nye Odorless Incinerator Co. in 1925.

About five hundred feet from the incinerator plant is located the Jackson Memorial Hospital, a 300-bed institution owned by the city, which was originally equipped with an oil-fired steam plant for furnishing steam for devices such as laundry mangles, cooking apparatus, sterilizers, etc. Oil for this hospital plant cost $10,117 during one twelve-month period, while just a few hundred feet away the incinerator was producing and wasting a large amount of heat. Study showed that one unit of the incinerator would generate sufficient heat to provide the required amount of steam. Money did not seem available for constructing an expensive plant and it was determined to install one at as low cost as possible without asking for an appropriation. An arrangement was made with the hospital authorities, whereby a portion of the money normally spent for fuel oil was diverted to the incinerator operating fund and a temporary loan was secured for construction purposes, the cost of which totaled $7,440. It was found that the gases entered the tank at about 1200 degrees, which made it necessary to secure a boiler with about twice the heating surface that would be required for coal. An old B. & W. water-tube boiler of the required size was purchased at a scrap price; it was dismounted and the tubes and drums hand blasted and scraped, pits drilled out, plugged and welded, a few new tubes installed, and the whole reassembled. Bricks were bought for setting the boiler and new steel for the breeching, but much of the other material came from the salvage pile. When the installation was completed, the boiler was given a cold water test of 187½ pounds pressure, and considered suitable for operation at 125 pounds. The boiler is 14 tubes wide and 9 tubes high, with standard double longitudinal drum, inclined header type, with three vertical passes; the heating surface being about 2268 sq. ft.

A 150-foot stack furnished draught for each incinerator unit and the steam boiler was set at right angles to the brick duct conveying the gases from one unit of two furnaces to its stack, in such a way that the gases passed into the setting at the place normally occupied by the coal grate.

The incinerators burn a mixture of garbage and rubbish just as it is received from the household, except that it is picked over for salvage, and scrap iron and glass are removed. The average heat content was found to be about 3,760 B.t.u., the ash content 25 per cent and the moisture 8.66 per cent.

Heat at 100 to 125 pounds is conducted to the hospital through 447 feet of 4″ line covered with 1″ magnesia pipe covering. The condensate is recovered and returned to the boiler, and as make-up water is secured from a water softening plant at the hospital, there are no scale or mud troubles in the boiler. The plant has been operated successfully since July 1, 1928.

The plant is shut down each sixty to eighty days for the purpose of cleaning dust and ashes from the tubes.

A test was run on the boiler in February, 1928, for the purpose of ascertaining the maximum amount of evaporation that could be secured from the plant under working conditions. Later, another test lasting for several days was conducted by outside interests with results approximately the same as those of the test run. Results of the test run are given below.

February 18, 1928. Duration of Test, 7.3 Hours

Average indicated horsepower	259 H. P.
Pounds of water evaporated	57,325.5 lbs.
Pounds of fuel fired	52,200 lbs.
Pounds of water evaporated per pound of fuel	1.1 lbs.
Heat content of fuel, as fired	3,760 B. T. U.
Percentage of ash	25%
Average steam pressure	117 lbs.
Average temperature of feed water	114 degrees
Temperature of gases entering boiler, average of 45 readings	1,819 degrees
Highest temperature of gases	2,140 degrees
Lowest temperature of gases	1,220 degrees
Temperature of gases in stack, average of 45 readings	777 degrees

Letting Road Contracts Early

It is with pleasure that the action of the Minnesota state highway department is viewed. Bids for contracts on 136 miles of pavement are now being received. This pavement is not to be built until 1930, but the contracts are being placed now—and just so much routine work is out of the way.

Early letting of road contracts brings with it manifold benefits: the contractor has ample time to make his plans; road machinery can be placed in operation at the crack of dawn on the first suitable day; costly delays are eliminated and full advantage can be taken of the all too short roadbuilding season; and the citizen feels his tax money will soon be at work for him.
—*November issue of "Colorado Highways."*

RECENT LEGAL DECISIONS

PAVING COMPANY LENDING EQUIPMENT AND MEN TO CITY NOT LIABLE FOR TRESPASSES ON ABUTTING PROPERTY

Action was brought by a lot owner against a city and a paving company for damages by the deposit of dirt on plaintiff's lot in working on a street. The paving company was held not liable, as it had no contract to do work on that street, but merely allowed the city to use its tools, steam shovel and men. No charge was made for the use of this property, but the city was required to pay the men's wages and the cost of operation and maintenance of the equipment. The paving company required the city to use its men on account of their special training in handling and taking care of the equipment; but they were under the sole control of the city. The city, however, whilst using the paving company's equipment, would be liable for any trespasses committed by the company's servants in the course of their employment. And as the plaintiff consented to the dirt being left on the lot if the city would cause it to be leveled, the damages recoverable would be those caused by failure to comply with this condition.

SANITARY SEWER ORDINANCE ENACTED IN VIOLATION OF ELECTION PLEDGES HELD VALID

The Kentucky Court of Appeals holds, Hodge v. Ctiy of Princeton, 13 S. W. (2d) 491, that an ordinance providing for the construction of a sanitary sewer system for the city was not invalid because it was enacted by the general council in violation of pledges of the members made while candidates for office. The corruption or bad faith which will subject the actions of municipal officers to review by the courts is such as concerns, or is connected with, their official actions, and has nothing to do with their conduct or promises while mere candidates for office.

STONE QUARRY IN CITY NOT A NUISANCE PER SE

The Missouri Supreme Court holds, Ex parte Davison, 13 S. W. (2d) 40, that an ordinance prohibiting the opening up of a stone quarry within a distance of 300 feet of any building, built and inhabited or used as a place of public assemblage, is unconstitutional. Such a purpose is not a nuisance per se, nor injurious to the health, morals, or safety of the community. The ordinance did not prohibit the use of explosives in operating a stone quarry, but simply opening one up. A stone quarry may be opened up and operated without the use of explosives.

REMOVAL OF GARBAGE HELD A GOVERNMENTAL FUNCTION—MUNICIPALITY NOT LIABLE FOR NEGLIGENCE OF EMPLOYEES

There is some conflict in the cases, but the weight of authority is to the effect that the removal of garbage by a municipality is a governmental function which is designed primarily to promote public health and comfort, and hence that the municipality is not liable therefor in tort when the negligence which is charged occurred in the performance of that particular function, and no nuisance is thereby created.

This appears to be the rule enforced not only in the federal courts but also in California, Georgia, Iowa, Kentucky, Massachusetts, Missouri, North Carolina, New Hampshire, New Jersey, Pennsylvania, Tennessee, and Wisconsin. The contrary rule seems to prevail in Colorado, Illinois, Mississippi, New York and Texas.

Stating the law as above, ,The Virginia Supreme Court of Appeals, Ashbury v. City of Norfolk, 147 S. E. 223, agrees with the rule as stated, holding that the city was not liable for injuries to a pedestrian on a sidewalk when the horses hitched to a trailer being used for the collection of garbage on the street ran away, owing to the breaking of a king pin fastening the double bar, which allowed the singletrees to fall on the heels of the horses.

PAVING MAINTENANCE BOND PROVISO ABSOLVING CONTRACTOR FROM DEFECTS IN OLD BASE DID NOT COVER PUTTING ASPHALT ON SMOOTH BASE

A maintenance bond for five years, given by a paving contractor, provided that the determination of the necessity for repairs should rest entirely with the street improvement district board, or, after the board turned the street over to the city, with the city engineer, whose decision on the matter should be final and obligatory upon the contractor. The Arkansas Supreme Court, in an action against the contractor and his surety for the sum the board had expended in repairs, Connelly v. Beauchamp, 13 S. W. (2d) 28, held that, in the absence of fraud or bad faith, the decision of the board was final. The bond covered defects in material or workmanship, but provided that the contractor should not be liable for damage due to defects in the old base used by the district. There was testimony that the damage was caused by putting the asphalt surface on a smooth base. It was held, however, that this was not a defect in the base meant by the parties when they made the contract. It was held proper to consider both the construction contract and the construction bond together with the maintenance bond; and, doing so, this was the conclusion arrived at. The contractor knew all about the smooth surface of the base when he executed the maintenance bond. The proviso in that bond did not mean the smooth surface of the base, but a defect thereafter appearing. So far as appeared, there was no defect in the base at the time of the trial. It was exactly as it was when the work was completed. It was held immaterial that the contractor wanted the engineer to change the plans, but the engineer refused to do so, the contractor continuing and completing the work on the old base. The work having been completed in that way, and the maintenance bond given, the defendants were held liable for the amount paid by the district for repairs.

WATER MAINS HELD TAXABLE AS REAL ESTATE AS APPURTENANTS OF PLANT AND NOT AS PERSONAL PROPERTY

The Missouri Supreme Court holds, State ex. rel. Sedalia Water Co. v. Harsenberger, 14 S. W. (2d) 554, that the water mains of a water company in the streets of a city are appurtenant to the company's pumping station and the real estate upon which the station is located, and therefore should be valued as

a part of the real estate for taxation under Mo. Rev. St. 1919, § 12967, which defines real estate as including "rights and privileges pertaining to" the land and fixtures thereon. The Supreme Court says: "The participle 'pertaining' as used in the statute includes the relationship of an appurtenance. It includes all *rights* and *privileges* connected with the plant situated upon the tract of land described, and must include the right to lay water mains in the street." In this case, the court said, the water mains in the streets are practically worthless considered as personal property, separated from the soil. They are necessary to the full enjoyment of the property. The plant located on the water company's land would be absolutely worthless without the pipes and the pipes would be worthless without the plant which supplies them with water. They are appurtenant within the definition: "An appurtenance is a thing used with and related to or dependent upon something else which is its principal."

The court adopts the rule laid down in the Iowa cases and says that the weight of authority and reason seems to be with that rule. It also cites Badger Lumber Co. v. Marion Water Supply Co., 48 Kan. 182, 29 Pac. 476, 15 L. R. A. 652, 30 Am. St. Rep, 301, in the footnote to which opinion many cases are cited illustrating the attitude of different courts regarding similar situations.

Whether pipe lines connected with a water plant are appurtenant to the real estate upon which the plant is located is sometimes controlled by statute. The defendant, the collector of revenue, cited Shelbyville Water Co. v. People, 140 Ill, 545, 30 N. E. 678, 16 L. R. A. 505, holding that such pipe lines are personal property and properly assessed as such, separate from the plant. An Illinois statute provides for just that method, and therefore the case was held not in point.

Judgment for the water company was affirmed.

CONTRACT TO COLLECT PAVING CLAIMS NOT INVALID FOR IRREGULARITY IN PROCEEDINGS

The Louisiana Court of Appeal holds, Gosserand v. City of Gretna, 121 So. 208, that when the mayor and board of aldermen had the power to make a contract with the city attorney to collect certain delinquent paving claims, the fact that there were irregularities and informalities in the call of the special session of the city council will not nullify the contract, especially when the city has profited by the completed work of that official.

COST OF SEWERS—NOT INCLUDED IN COST OF INTERSECTIONS

The Kentucky Court of Appeals holds, Lawson v. City of Greenup, 13 S. W. (2d) 281, that the provision in Ky. Acts 1928, c. 98, that the cost of intersections and crossings shall be paid by the city does not apply to the cost of construction of sewers.

It is also held that a city council may divide the city into three drainage areas and then treat the entire system as one unit for the purpose of assessing the cost of its construction. This is a matter within the discretion of the city council. Whatever may have been the reason actuating the board to divide the city into three areas, there was nothing to indicate that the entire territory affected by the improvement was not equally benefited.

COST OF CITY'S SEWERAGE SYSTEM WITHIN DETERMINATION OF LEGISLATURE

Where the construction of a sewerage system by a city is authorized, the propriety and justice of the expenditures and amounts to be raised for their payment are within the determination of the Legislature, and the courts cannot review its discretion. White Provision Co. v. City of Atlanta, Georgia Court of Appeals, 145 S. E. 109.

DETERMINATION OF ASSESSMENT FOR LATERAL SEWERS

The Georgia Court of Appeals holds, Etheridge v. City of Atlanta, 145 S. E. 84, that in fixing the amount to be assessed against owners of abutting property to cover the cost of constructing lateral sewers and connections therewith to private property, the cost of building, repairing and upkeep of trunk sewers and disposal plants may be considered; and for the privilege of connecting with such trunk lines a reasonable sum may be added to the actual cost of lateral sewers and property connections.

INSUFFICIENTLY SIGNED PETITION BARRING RECOVERY OF COST OF PAVING AGAINST CITY

The Louisiana Court of Appeals holds, Grasser Contracting Co. v. City of New Orleans, 118 So. 841, that a paving contractor has no recourse against the city for the share of the cost of paving assessed against a front proprietor who successfully defends a suit for collection thereof, when it appears that 52 per cent of the interested property holders did not sign the petition for the paving under section 42 of the City Charter.

PAVING ORDINANCE HELD SUFFICIENTLY DEFINITE AS TO MATERIAL THOUGH CALLING FOR ALTERNATE BIDS

The Alabama Supreme Court holds, Stovall v. City of Jasper, 118 So. 467, that an ordinance providing that a certain street "shall be paved with street asphalt, asphaltic concrete or bitulithic pavement, together with such sidewalks, walls or curbing, drain-pipes, storm inlets, manholes or other work pertaining to the satisfactory construction of said pavement" was definite as to material to be used, or became effective and definite by the coming in of the alternate bids and the selection and approval by the duly constituted authority of the city.

FAILURE TO GIVE BOND NO DEFENSE TO BREACH OF PUBLIC WORKS CONTRACT

The Texas Court of Civil Appeals holds, State v. Scholz Bros., 4 S. W. (2d) 661, that Rev. Stat. 1925, art. 5160, which requires parties entering into contracts with the state, or its counties, districts, and other subdivisions thereof, for the construction of public buildings, to give the "usual penal bond," cannot, when the contractor fails to give the bond, be used as a defense against breach of the contract. The requirements of that article are in the interest of the state, and not of the delinquent contractor, who seeks to evade his contract by canceling the bond given by him. Public works contractors after making the contract could have been compelled to give the bond. The contract was binding without it.

The court also said that a mistake in arithmetic made by a party bidding on a contract to erect a building, such mistake not having been induced by the other contracting party, but consisting in an error in addition by the bidder, is not an excuse for breach of a contract.

Engineering Societies

March 21-22—NEW JERSEY SEWAGE WORKS ASSN. Annual meeting at Trenton, N. J. John R. Downes, Secy., Bound Brook, N. J.

April 15-17—SOUTHEASTERN SECTION, AMERICAN WATERWORKS ASS'N. Annual meeting at Savannah, Ga. F. W. Chapman, Secy., Water Dept., Camden, S. C.

April 17-19—FLORIDA ENGINEERING SOCIETY. Annual meeting at Ocala, Fla. J. R. Benton, Secy., Gainesville, Fla.

April 23-24—ILLINOIS SECTION, A. W. W. A. Annual meeting at Stevens Hotel, Chicago, Ill. J. J. Doland, University of Illinois, Urbana, Ill.

May 10—NEW YORK STATE SEWAGE WORKS ASS'N. Earl Devendorf, 23 South Pearl St., Albany, N. Y.

May 26-31—NATIONAL FLOOD CONTROL CONGRESS. Memphis, Tenn. R. E. Logsden, Chamber of Commerce, Chisca Hotel, Memphis, Tenn.

June 2-6—AMERICAN WATER WORKS ASS'N. Annual convention at St. Louis, Mo. Beekman C. Little, Secy., 29 West 39th St., New York.

Highway Officials of the North Atlantic States

The sixth annual convention of the Association of Highway Officials of the North Atlantic States, which was held at Syracuse, N. Y., February 19-21, was well attended. As usual at the convention of this association, a number of excellent papers were presented by authorities on highway subjects.

The Wednesday morning session was given over in part to the usual preliminaries and welcoming addresses. Following these was a paper on the now popular subject of prequalification of bidders, which was presented by H. H. Wilson, vice-president of the Associated General Contractors. This evoked considerable discussion, which was led by E. P. Forrestel, formerly president of the New York Chapter of the A. G. C. While nothing particularly new was brought out on the subject, it aroused considerable interest.

The second paper scheduled for the opening session was one on "Construction, Maintenance, and Marking of Detours," by W. A. Van Duzer, assistant chief engineer of the Pennsylvania Department of Highways, which was followed by a general discussion.

Only two papers—both rather long—were presented at the afternoon session Wednesday. The first dealt with the subject of low cost road types, with special emphasis on one-lane pavements, a type of construction which has received some attention in central New York. This was given by Squire E. Fitch, superintendent of highways of Chautauqua County, New York. The discussion which followed was led by E. E. Reed, assistant State Highway Engineer of New Jersey, who paid particular attention to gravel road construction and maintenance. Following this was a short discussion by a number of state representatives on one-lane practice in their states.

"Organization and Authority of Testing Laboratories" was the subject of a paper by H. S. Mattimore, engineer of tests and material investigations of the Pennsylvania Highway Department. This was discussed by C. C. Ahler of the New York Division of Highways.

C. A. Hogentogler of the Bureau of Public Roads opened the Thursday morning meeting with a paper on soil tests and treatment. He was followed by George E. Hamlin, superintendent of repairs, Connecticut Highway Department, who spoke on "Shoulder Hardening and Maintenance." This paper was discussed by D. A. Soule, maintenance engineer of Rhode Island. The final paper of the morning was by Harold W. Giffin, field engineer of the New Jersey Highway Department, who discussed "By-Passing Cities and Villages."

There were only two papers Thursday afternoon: "Penetration Macadam Design and Methods of Construction," by C. L. Wooley, construction engineer of the Rhode Island Board of Public Roads, and "Aerial Surveys in Highway Planning," prepared by S. D. Sarason, of Syracuse University, which was discussed by Major Theron M. Ripley of Buffalo.

The annual smoker was given Thursday night at the Hotel Syracuse.

N. Watson Hardenbergh, supervisor of repairs, State Highway Department of Connecticut discussed "Maintenance of 'Washboardy' Macadam Roads" Friday morning. Following general discussion, L. D. Barrows, chief engineer of the Maine Highway Department, presented a paper on winter maintenance including sanding, draining and snow removal.

The final session was held Friday afternoon. Guy W. Pinck, district engineer of the New York State Division of Highways, discussed "Retreads," and H. F. Gonnerman of the Portland Cement Association Research Laboratory spoke on "Determining the Suitability of Aggregates for Concrete Pavements."

Florida Short Course in Water and Sewage

The University of Florida through its Extension Division, the Florida State Board of Health, and the Florida Section American Water Works Association will hold a four day Short Course on Water Purification and Sewage Treatment at the University of Florida, Gainesville, April 8, 9, 10 and 11th.

The Short Course School will start at 2 P. M., the afternoon of the 8th and the 5th Annual Meeting of the Florida Section American Water Works Association will start on the morning of the 10th. All sessions of the school will be held at the University of Florida, Department of Chemistry, under direction of Professor A. P. Black and will consist of lectures, tests and demonstrations on water works and sewage problems especially those relating to chlorination, coagulation, bacterial control and

For Late Information on Sewage Treatment and Refuse Disposal, see pages 80-81 in the rear.

pumping problems. Registration for the school should be made at once.

The headquarters for those in attendance at the school and meeting will be the White House Hotel at Gainesville, and hotel reservations should be made promptly.

A faculty of men from all parts of the country will be present and water works men of Cuba have been invited to attend.

The program will be issued later and information may be obtained from E. L. Filby of the State Board of Health, Jacksonville, Fla.

New Jersey Sewage Works Association

The 15th annual meeting of the New Jersey Sewage Works Association will be held March 21 and 22 at the Hildebrecht Hotel, Trenton, N. J.

There will be papers on operating experience by F. M. Veatch, Kansas City, Mo.; Chas. Hommon, Canton, Ohio; Chas. Capen, Orange, N. J.; C. H. Shute, Glasboro, N. J.; and A. W. Dare, Bridgeton, N. J.

Other papers will include: Drying Sludge under Glass, by Floyd G. Browne, Marion, Ohio; Drying Green Sludge for Fertilizer, by Chester G. Wigley, Atlantic City; Mosquitoes and Sewage Disposal; Ginsberg and Forman, Control of Breeding in Disposal Works; Lester Smith, Control of Breeding in Cesspools.

The New Plant at Red Bank, N. J., by H. Burdett Cleveland, New York; Experience with Activated Sludge, by Maj. M. Blew, Philadelphia; The Biology of Sewage Disposal, by Dr. Heukalekien, New Brunswick, N. J.

Round Table Discussions: Odor control, operator problems, standard greenhouse construction, suitable paints, suitable pipe construction, and sludge drying.

Maryland Water and Sewerage Association

The Fourth Annual Conference of the Maryland Water and Sewerage Association will be held in Hagerstown, May 13 and 14, 1930, with headquarters at the Alexander Hotel. F. W. Caspari, Baltimore, Md., is secretary.

Associated General Contractors

At the annual meeting held in New Orleans, La., the following officers and directors were elected: President, A. E. Horst, Rock Island, Ill., and Philadelphia, Pa.; vice-president at large, James E. Cashman, Burlington, Vt.; vice-presidents, H. P. Treadway, Kansas City, Mo., and T. H. Banfield, Portland, Ore.; directors, districts 2 and 3, Frank S. Bache, White Plains, N. Y., and E. P. Forrestel, Akron, N. Y.; districts 4 and 5, W. R. Hughes, Jr., Philadelphia, Pa.; district 7, T. J. Baker, Milwaukee, Wis.; districts 12 and 13, Ashton Glassell, Shreveport, La.

The board of directors appointed a council of four members to serve with the president in lieu of a general manager in directing the affairs of the association during the ensuing year. In addition to President Horst, this council consists of George B. Walbridge, Detroit, Mich.; Frederick L. Cranford, Brooklyn, N. Y.; Alan Parrish, Paris, Ill., and W. A. Bechtel, San Francisco, Calif. The board also appointed an executive committee to consist of President Horst, Vice-Presidents Cashman and Treadway and T. J. Baker, of Milwaukee, T. T. Flagler, of Atlanta, H. H. Wilson, of Harrisburg, and John W. Cowper, of Buffalo.

New York State Sewage Works Association

The next meeting of the New York State Sewage Works Association, which will be the annual meeting, will be held at Albany, N. Y., May 10. Earl Devendorf, 23 South Pearl St., Albany, is in charge of arrangements for the meeting.

American Engineering Council

Selection of administrative officers to carry out plans for national activity in public affairs during 1930 are announced by the American Engineering Council. Major Gardner S. Williams

(Continued on Page 50)

Plain Grit Chambers have no Place in the Modern Sewage Treatment Plant

Just as old-fashioned, plain settling tanks have been superseded by Dorr Clarifiers, so are plain grit chambers giving way to Dorr Detritors in up-to-date sewage treatment plants.

Dorr Detritors solve the grit removal problem by continuously collecting the grit in the flow, *washing* it, and discharging it in a clean, drained condition. The grit as discharged is practically free from organic material and it can be used on roadways or as fill around the plant, without causing offensive odors.

The illustration shows the Dorr Detritor in the recently-completed sewage treatment plant at Middletown, N.Y., designed by Fuller & McClintock.

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The operation of the Dorr Detritor is described in Bulletin No. 6481. Our nearest office will gladly send you a copy.

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BOOKS AND PUBLICATIONS

Sewerage and Sewage Disposal.—By Leonard Metcalf and Harrison P. Eddy. Second Edition. McGraw-Hill Book Co., New York. 224 illustrations, 743 pages. $6.

This is an amplified and expanded edition of the original text of this title which was first published in 1922. As stated in the preface, the book has been about completely rewritten, and the intention has been to make it more valuable and adaptable for classroom use. To this end, Prof. Tyler of M. I. T., and Prof. Fair of Harvard were called upon to aid, and letters were also sent to all professors, known to have used the first edition, asking for suggestions. The result is a most complete text, but this reviewer, who has had some, but rather limited, experience in college instruction, does not see how any considerable part of it can be covered in the time usually allotted to sewerage in the average engineering schools.

For the engineer, this has no weight; and he will find it an excellent and up-to-date book. Though based on the 3-volume work put out some 15 years ago, the recently revised "Design of Sewers," a lot of additional material has been made available.

There seems to be but little new in the treatment of quantity of sanitary and storm sewage, and in hydraulics which is to be expected. In general, the matter is an expansion of the former text. The problem of designing sewers appears to be treated exceedingly well, and in a fashion that will be of value to the student.

A good deal of space is given to disposal by irrigation, especially surface irrigation, and a great deal of foreign practice is cited. Probably the student will skip this. The subsurface irrigation data given are those of the A. P. H. A. committee, which theoretically are fine, but were prepared by people having, for the most part, small practical experience in the matter. If applied literally they would be a most disturbing factor in actual health work involving rural sanitation.

In discussing the principles of treatment, there is much space devoted to the theory of sedimentation, and the limitations of this theory. This is of value to the designing engineer, but doubtful for the student pressed for time. Chemical reactions involved in chemical precipitation cover several pages.

On the whole, however, the material on treatment is very good, being both up-to-date and thorough. For the practicing engineer, there is a great deal of information in a readily available form.

An unusual feature, and one of value to the student, is the outline at the beginning of many chapters, enumerating the objectives or the means by which the processes covered in that chapter are accomplished. Following the chapters, are given a list of problems for the student to work out.

The book is an excellent one and covers the field very well. Yet for the student there is much material covering details of operation and design, which he will not use for many years, when, presumably, newer methods of sewage treatment will require newer texts for presentation.

Vom Wasser.—Yearbook for water chemistry and sewage treatment. Vol. 3, 1929. Publ. Verlag Chemie. G. M. B. H. Berlin W 10. Pages 282, 20 tables and 101 cuts. Price 20 Marks, bound 21 Marks.

Reviewed by Prof. Willem Rudolfs

The third volume of the yearbook Vom Wasser contains the papers (with discussions) given before the annual convention of the German water chemists and water engineers held at Breslau on May 22-25, 1929. In the field of water purification several papers are of interest. Eggers describes studies on the flow of water through filters traced with fluorescein, Engler the purification of surface waters containing humic acids. Pick gives results on de-chlorination with active carbon, Olszewski discusses disinfection with silver salts and Katadyn silver, Naumann describes apparatus and methods of measuring turbidity, light absorption and interferometry in water analyses, Czensny gives an improved method of pH determinations, and Austin discusses the permanganate and chlorine consumption in water containing large quantities of iron. A long and interesting paper by Prof. Bruns treats the relation between water borne epidemics and water purification. Several water works are described by others.

The importance of removing substances in solution from boiler water is stressed by Splittberger.

A number of papers deal with sewage disposal. The Breslau plant is described by Weber. Mieder summarizes the findings of his trip to the U. S. A. in relation to sewage disposal and Hilland about water purification. Sludge digestion is discussed by Heillmann (Halle) and sewage chlorination by Viehl. Czensny gives methods of determining polluting matters like tar and phenols and its treatment is discussed in three papers, one of which deals with the chlorination of the waste water. Finally, Bach gives a review of the present and probable future tendencies in water purification and sewage treatment and a resume of improvement in chemical analyses of water purification during the last five years.

There are several papers and some very valuable discussions printed in the book which are of particular interest to water works chemists and sanitary engineers in this country. Although the paper cover of the book is slightly better than last year, the book should be bought bound.

Formulas and Tables for the Computation of Geodetic Positions (Seventh Edition.)

This publication contains the formulas and tables that are used by the U. S. Coast and Geodetic Survey for the computation of geodetic positions. A complete explanation of the problem is given and examples of computation are shown.

A list of the contents of the publication is as follows: Solution of triangles; spherical excess; number of decimal places in angles and lengths; computation of differences of latitude, longitude, and azimuth; examples of computation: computation of triangles, first-order position computation, inverse position computation, inverse solution, table of arc-sin corrections for inverse position computations.

Table of log m, corrections for difference in arc and sine, log. sec., conversion table, logarithms of factors and constants for the reference spheroid are given.

The appendix contains historical data and development of formulas, dimensions of spheroid, formulas and factors for the computation of geodetic latitudes, longitudes, and azimuths, development of formula for spherical excess, and international ellipsoid.

This publication is sold only by the Superintendent of Documents, Government Printing Office, Washington, D. C. The sale price is 30 cents. Postage stamps will not be accepted by the Superintendent of Documents in payment for publications.

Compressed Air Trade Standards.—The Fourth Edition of the Trade Standards of The Compressed Air Society has just been published, and copies may be had upon application to C. H. Rohrbach, Secretary, 90 West Street, New York. Price, fifty cents each.

New material in the pamphlet comprises a new formula for use in air compressor testing, this being accurate for higher water columns than that previously used, thereby extending the capacity of a nozzle of a given size through a greater useful range; further suggestions in connection with the installation and operation of air compressors; caution against the use of old boilers or tanks as air receivers; suggestion for handling very cold "cooling water" so as to prevent condensation and undue wear on the air cylinders; and another illustration of an air cleaning device.

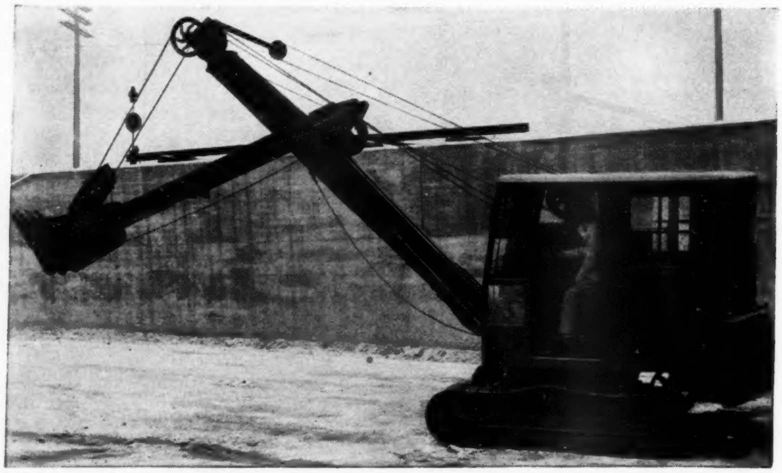
Sewerage and Drainage.—The Ric-Wil Co., Cleveland, O., has brought out a new bulletin, which illustrates and describes their sewer and drain products. Considerable cost data are included.

Engineering and Construction Equipment

New Machinery, Apparatus, Materials and Methods and Recent Installations.

The "Ace" Full-Swing Gasoline Shovel

The Western Mfg. Co., Detroit, Mich., has brought out the "Ace" gasoline shovel. The manufacturers state that the design of this shovel has been dictated by the requirements of contractors and those interested in the efficient handling of materials. Engineers have spent three years in developing the unit, and while the Ace possesses many features not found heretofore in power shovels of small capacity, these features nevertheless, are extremely practical. Their application to this field offers a distinct advantage to the owners of Ace units, assuring them of ample power, speed and low yardage costs.



The Ace Full-Swing Gasoline Shovel with Many New Features

Aside from the track and engine, 95 per cent of all bearings are of the ball or roller type. Friction losses are kept at the minimum, making more power available for productive work.

The power plant is a six-cylinder Hercules engine, developing in excess of 50 h.p. at 1400 r.p.m., its governed speed. The Ace has more than sufficient power to handle the severest type of work.

The transmission provides two speeds in each direction, and has four power take-off outlets. The lower center shaft drives the shovel mechanism, direct from the engine, at 1400 r.p.m. The upper center shaft, geared for 750 r.p.m., is used for driving the generator when a magnet is required. The left hand shaft travels at either 500 or 1000 r.p.m. in either direction, and operates the crawler tracks at one or two miles per hour.

One of the most desirable features of the Ace is its hydraulic control. (A three-lever manual system is optional.) The hydraulic system, of the Lockheed type, the same as is used for automobile brakes, enables the operator to control all shovel operations with a single lever.

In addition to this single lever for all shovel operations, there are two brake pedals, for the hoist and crowd, and two control levers for the crawler tracks, all mounted in a single, clean-cut assembly.

This machine has been specially designed for conversion to other types, and it may be used as a power shovel, clamshell, trench hoe, crane, dragline, backfiller or magnet crane.

The Abernathy Adjustable Steel Form

C. G. Abernathy, Hornell, N. Y., has developed a new type of steel form for road construction.

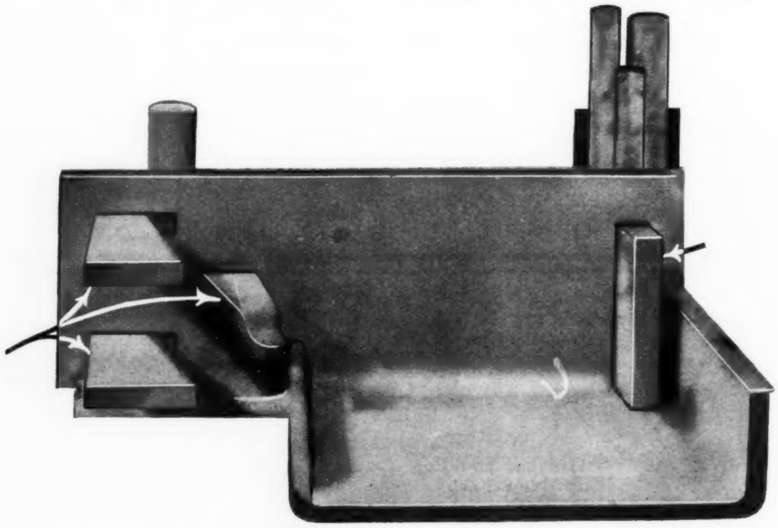
The prime object of this type form is to eliminate the painstaking and expensive task necessary to prepare accurately the grade to receive the present type form. In using this form it is necessary only to carry the grade to within three and one-half inches of the true grade, then, after the grade has been thoroughly rolled, the forms may be set and brought to the proper position by the wedges. If sufficient care is taken when the grade is being prepared no hand work will be necessary, such as cutting or filling and tamping under the line.

Numerous tests conducted this past season on several different contracts have shown that four men can set, line and grade two hundred and fifty feet an hour.

The following method of setting these forms has been found to give the best results: The rails and pedestals are first strung out and then a pedestal is engaged under the end of each rail and set as close to the line as possible. Then after the stakes have been driven, the wedges are moved one way or the other until the rails are to the proper line and grade, there being a 3½-inch vertical and an inch and a half lateral adjustment. The center pedestals are then placed under the rails, the stake driven and the wedges tightened up, and the forms are ready for the concrete.

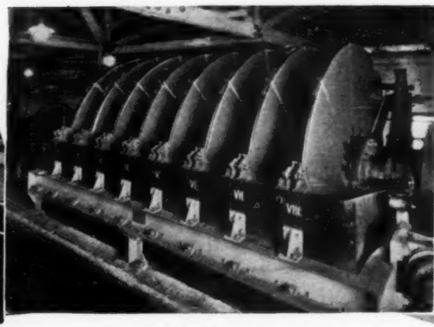
Some of the important features to be found in this new form are said to be: Ease in setting; a reduction of from 50 to 65 per cent in form setting costs; no pockets to become filled with concrete; less form settlement, which is due to the fact that a hard bearing surface may be prepared and this same bearing surface maintained although it may be necessary to move the rail up or down or sideways.

A tipping or rocking motion of the rail is one of the causes of form settle-

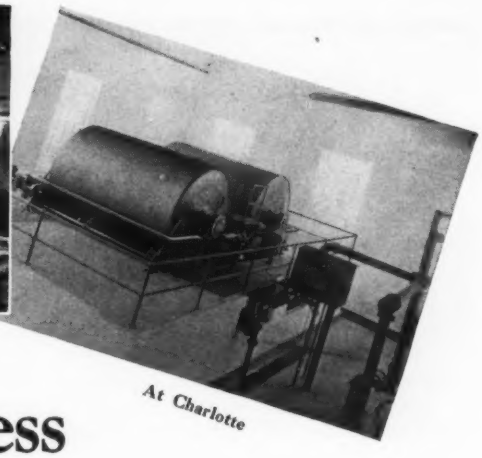


Pedestal and Adjusting Devices, Abernathy Adjustable Form for Concrete Highway Construction

At Milwaukee



At Houston



At Charlotte

Clean, Odorless

Profit-Producing Sewage Treatment

YOUR community will appreciate activated sludge treatment of the sewage. It is clean, odorless, fly-free.

Your taxpayers will appreciate the profit-producing phase of activated sludge treatment in that the solids after filtration are suitable for fertilizer and are being sold as such.

Oliver United's part in this modern sewage treatment program is to provide the filters. Units are already in service in Gastonia and Charlotte, N. C., in Houston, Texas, in Pasadena, California, in the Calumet station in Chicago and in Milwaukee. High Point, N. C., is now installing its Oliver United units.

As our engineers have a good understanding of activated sludge treatment, may we suggest that you call them in even when the project is in its initial stages?

OLIVER UNITED FILTERS INC.

JOHANNESBURG
E. L. Bateman
TOKYO
American Trading Co., Inc.
MELBOURNE
Fyvie and Stewart
HONOLULU
W. A. Ramsay Co.
MANILA
The Edward J. Nell Co.

Factories:
Oakland, Calif., Hazleton, Penna., Peterboro, England
Cable Address: OLIUNIFILT

TIMMINS, ONTARIO
B. D. Kelly
HALLE, GERMANY
Wilhelm Lill
SCHEVENINGEN, HOLLAND and SOERABAIA, JAVA
Van Lelyveld and Co
RECIFE, BRAZIL
Ayres and Son

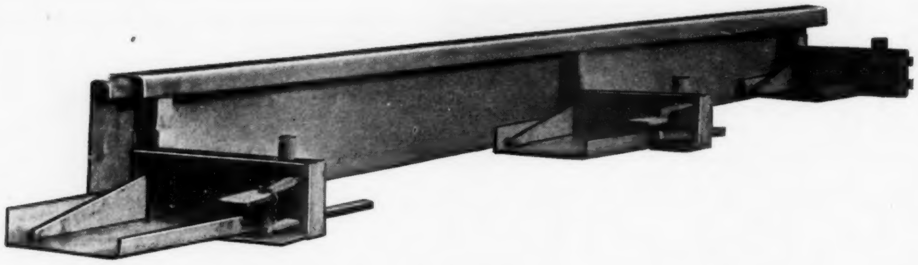
SAN FRANCISCO
Federal Reserve Bank Building

NEW YORK
33 W. 42nd St.

CHICAGO
565 Washington Blvd.

LONDON
150 Southampton Row

PARIS
T. L. Genter, Concessionaire
63 Ave. des Champs Elysées



The Abernathy form is adjustable both horizontally and vertically and is also easy to set.

ment. In this form, the fact that the base of the pedestal is greater than the height of the rail, and that the stake is driven at the outer edge of the pedestal, precludes any tendency to rock or weave back and forth with the motion of the screed.

This rail weighs about seventy-five pounds and the pedestals about thirty pounds each. The pedestals should last for a number of years, and if it becomes necessary to replace some of the rails, they can be bought for about forty cents a foot. If, for instance, it became necessary to change from an eight to a nine inch rail, the same pedestal can be used and the higher rail can be furnished at forty or forty-five cents a foot, depending on the width. The same pedestal can be used for any width from six to twelve inches by changing the square post upon which the rail is suspended.

Two stakes are all that is used instead of three of four. Another important feature is that, once the stake is driven, it is not necessary to disturb it in any way in straightening up the line, as this is all done with the wedges.

Highway Truck Concrete Mixers

The Highway Truck Mixer Co. Cleveland, O., manufacture the Highway Truck Mixer, a complete, single motored unit for handling concrete from weighing batchers to the job without an elevating body to discharge the batch. The mixing drum is driven direct from the truck motor. The number of drum revolutions may be controlled for any specified mixing period by a batch meter and lock over which the driver has no control, thus assuring a thorough mix either in transit or stationary mixing. The gear box is provided with a low speed for in-transit mixing, a higher speed for mixing on the job, if required, and suitable reverse speeds for controlling the discharge. The throttle gives full range of variable control over drum speed. At the point of delivery the batch is discharged clean simply by reversing the drum. All operating controls are conveniently handled from driver's cab.

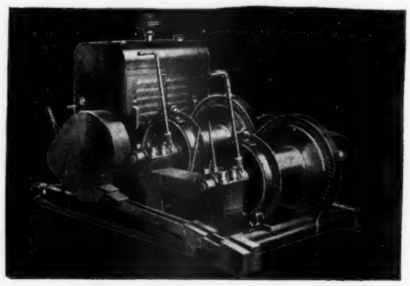
Every batch going into the mixer can be as accurately weighed and measured as is possible in a central mixing plant. The set-up consists of a standard bin to which weighing batchers, for aggregates and cement, and a water regulator are attached. All controls are banked for one operator. The cost of this loading equipment for Highway Truck mixers is much less than is required for central mixing plants.

While all mixers are equipped with graduated tanks which supply water for any complete batch, an accurate water regulator designed for mounting direct on the bin platform is recommended and can be furnished. This gives the bin operator the same dependable control over the water as over the other batch materials, although this measured water can be loaded into the water tank on the mixer if it is desired to haul a dry batch and add the water at the destination.

The water regulator is calibrated in both pounds and gallons and accurate adjustment for any quantity is practically instantaneous.

New Dake Gas and Electric Powered Hoists

The Dake Engine Company of Grand Haven, Michigan, has announced



The Dake Hoist

a new line of gasoline or electric powered hoists. There are seven hoists ranging in size from 2 h.p. to 27 h.p. Following the usual Dake design the side frames, which support the shaft bearings, and the base are made in one piece.

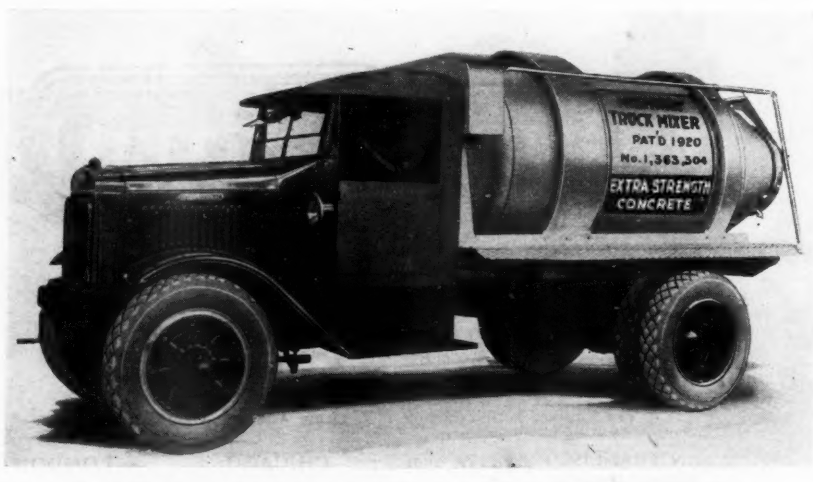
The one-piece frame of the five sizes up to 20 h.p. are made entirely of steel by the electric arc-welding process. The steel channels, which are the side members of the base, serve as skids and are drilled for both holding down bolts and anchor chains. The cross members of the frames are angles and tubes. This construction has strength and rigidity and is at the same time comparably light. The hoisting drums with ratchets and brake drums are likewise of one-piece electric arc-welded steel construction.

Bronze bushed cams running on the drum engage the friction clutch. Two ball thrust bearings minimize the operating lever pull and carry the clutch thrown-in forces which act in compression on the one side frame. A drilled and keyed collar takes up the wear of the wood friction blocks and adjusts the end movement of the drum.

The brakes are the band type with one fixed end. The bands are made in two parts and fastened together with an adjusting bolt conveniently placed on the top of the drum. Operated by a powerful rocker and lever, the brakes are smooth, positive, and applied with a very light pedal force.

The 20 h.p. and the 27 h.p. sizes have cast frames and Timken tapered roller bearings on all the power shafts. These bearings carry both the radial and the thrust loads and markedly increase the efficiency.

To meet the varied demands for small power hoists these Dake LG hoists are standard with either gasoline or electric power units and each size is made with a choice of three standard loads and speeds.



3-Yard Highway Truck Mixer Unit on International Harvester Chassis

Flexadrive for Speeding Up Trucks

The Western Mfg. Co., Detroit, Mich., has developed Flexadrive, which is a device to be installed on trucks. It is stated this device results in increased power and increased flexibility and more trips per hour, with fewer trucks on the job. In actual demonstration a Flexadrive Ford cut the time per trip from 5¼ to 3½ minutes and reduced the number of trucks necessary from 5 to 3. The upkeep and depreciation of two trucks and the wages of two drivers were saved.

Flexadrive reverses the gears and converts the truck into a front wheel drive. The load is pulled—not pushed. Increased power conservatively estimated at 20% results. This means maximum loads under all conditions whether the haul be on the level or up steep grades.

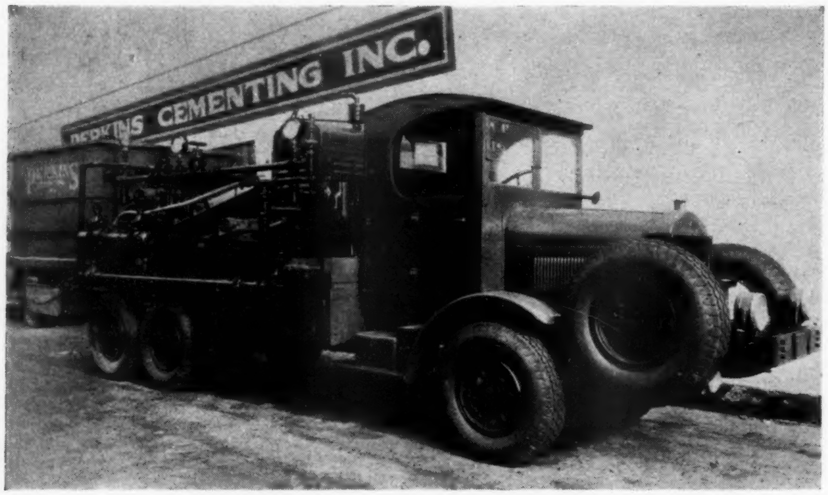
Flexadrive can be installed in one day by a competent automotive mechanic. All necessary parts are supplied and complete instructions sent with each Flexadrive. Any standard make of dump bodies may be used. The elimination of the cab and the placing of the driver's seat over the fender makes it possible to use a body of greater capacity, if desired.

New Three Axle Tandem Truck

Tandem arrangement of three sets of wheels is a distinctive feature of the six-wheeled truck, Model X6, brought out by the Four Wheel Drive Auto Company, Clintonville, Wisconsin. This wheel arrangement is designed to increase loading capacity, to reduce hauling costs, to maintain high speed operation, and to reduce road shock.

With an equal distribution of load weight to three axles, the 87-h.p. motor performs up to the truck's six tons loading capacity; with no increase in operating expense the ton-mile hauling costs consequently are reduced. High speed operation permits a closer hauling schedule—another economy claimed for the truck. Riding smoothness is obtained through the rear spring suspension method. These springs, of semi-elliptic type, are so hung that, acting as levers with the load midway between the fulcrum ends, as any one of the rear four wheels passes over an obstruction or into a depression, the load rises or falls but half the distance.

Motive power is applied to the front and to the foremost of the rear two axles through a center differential located in the subtransmission. In this center differential, allowance is made automatically for the difference in travel between the short curve and the wide curve sets of wheels as the truck rounds a corner or passes over obstructions and unever ground. This is the only four wheel driven six-wheel truck on the market having such compensation facilities, it is stated.



The F. W. D. 3-Axle Tandem 6-Wheel Truck

Self-Priming Contractors' Pumping Equipment

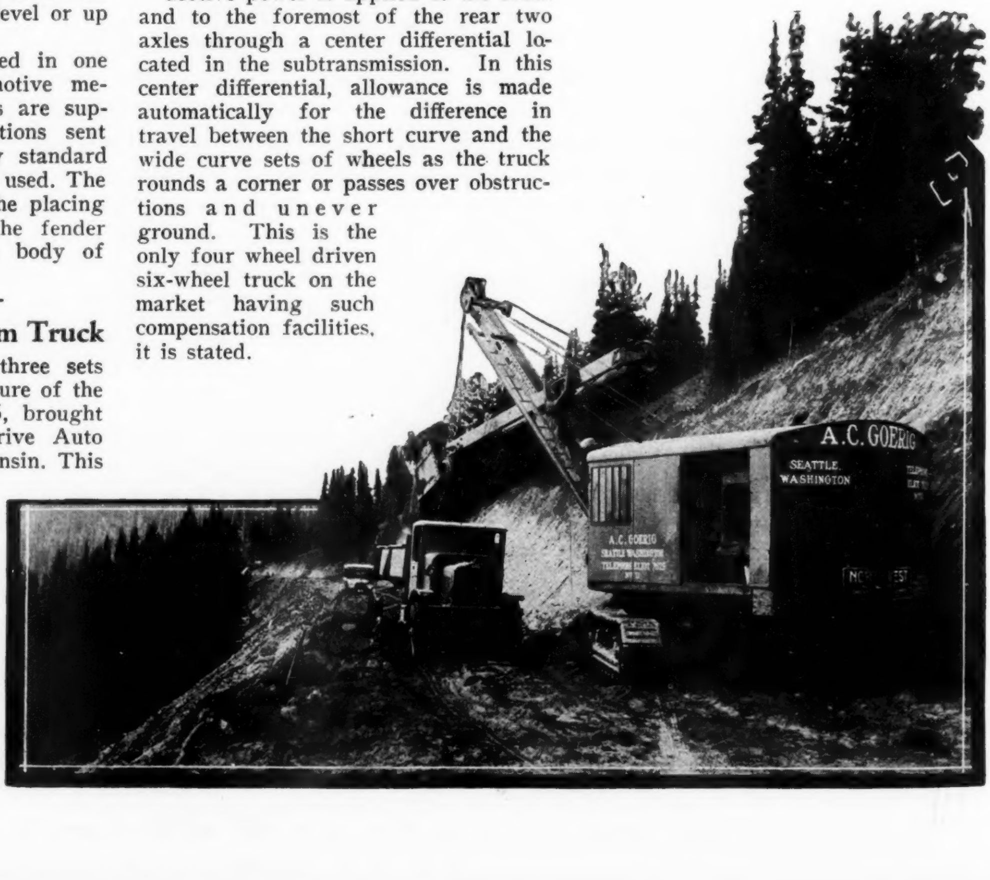
The Ralph B. Carter Company, of Hackensack, N. J., manufacturers of the Humdinger line of contractors' pumping equipment, have just placed in production an entirely new type of contractors' self-priming centrifugal pump.

This pump eliminates entirely all priming devices and mechanisms with their necessarily intricate working parts and valve mechanisms, floats, clutches, chain drives, etc., and primes itself continuously and automatically without attention of any kind on all suction lifts up to 28 feet. Its large air capacity gives it an unusually quick priming time and makes it extremely advantageous for use in connection with well point systems.

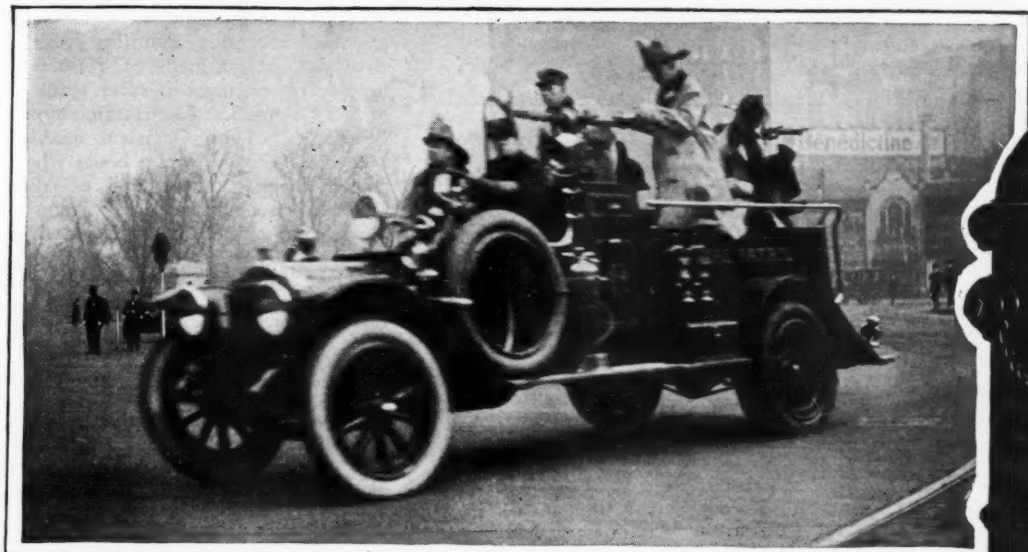
The pump unit is of the very latest type of centrifugal pump, ball bearing construction, of the highest grade grey iron casting, with a non-clogging type of three-vane open impeller, allowing the passage of unusually large solids and large percentages of mud and sand through the pump without damage.

Its greatest feature is its absolute simplicity and lack of any intricate or delicate priming mechanism, as it operates on an entirely new principle under which the water itself actually does all of the priming work.

These new outfits are mounted on extremely sturdy trucks of both a bolted and welded construction and equipped with the latest type of vertical gasoline engines. The unit is manufactured in 2, 4 and 6-inch sizes, having capacities up to 1800 gallons per minute.



A Northwest shovel loading into a White "55" truck equipped with Wood hoist and body and Christie crawler attachment, on highway construction in Rainier National Park. A. C. Goerig of Seattle, Wash., is the contractor.



The Fire Department is on the way but—COLUMBIAN hydrants *are already on the job*

Clang! the fire engines go sirening across town. Now they stop . . . hose lines are drawn off . . . where's the fire hydrant? It's there, been there like a silent sentinel for five, ten, fifteen years waiting for this moment of emergency.

Will it function smoothly under high pressure at a moment's notice after all these years of disuse? It's too late to do anything about it now. The time to think of these things is when the fire hydrants are installed.

What test can you make then? Here are three fundamental facts to check. What about the valves inside . . . is the alignment fixed so that they will open instantly no matter when the emergency comes? Only when the castings for the hydrants have been "aged" to remove all internal strain can you be sure.

Does the hydrant provide a dependable automatic drain? What is the service record of these hydrants . . . does that record prove they will last as long as the pipe? The Columbian folder anticipates these vital questions and answers them. May we mail you a copy?

Columbian
IRON WORKS
CHATTANOOGA, TENN.

What does "4 point" contact mean?

It means that in Columbian valves the discs wedge against the valve gate at four separate points of contact . . . and that leakage is eliminated. It means that in opening the valves all pressure is removed from the discs before they are lifted out of position and that there is no strain, hence no chance for breakage, of the valve stem. Seat rings are faced after being screwed into position. . . assuring absolute alignment and making sure the seat rings are parallel to each other.

Pontiac Mounted Lincoln Arc Welder

The new Lincoln stable arc welder mounted on the McCormick-Deering tractor is announced by the Pontiac Tractor Company of Pontiac, Michigan. This unit is furnished in either the 200 or 300-ampere machine and gives a wide range of utility.

The extension frame in this mounting is such that the tractor is simply set into a 4-inch I-beam and the front axle assembly is set ahead under the frame thereby lengthening the wheel base. This construction reinforces the tractor and gives it balance making it easy to steer with the added weight. The welder unit complete with the panel is mounted on this frame member ahead of the tractor and takes its drive from the power pulley at the side of the tractor by a belt. This makes a compact self contained unit capable of moving about under its own power. The 48x4 dual tires used in the rear give this unit a road speed of 15 miles per hour.

The Wiard Grade Ripper

The Wiard Plow Co., Batavia, N. Y., manufacture the Wiard Grade-Ripper scarifier or gang-rooter. The Grade-Ripper weighs 1425 lbs. The frames are made from open hearth steel; all rivets are driven hot. Teeth are made from special high carbon steel. The wheels are steel with heavy wide bearings of composition bearing metal with special grease reservoir, alemite greasing system and protected from dust.

The power required to operate the grade-ripper depends upon the work involved and the material. On light scarifying operations a small tractor is all that is required. When drawn by a large tractor, road roller, or high powered motor, gravel and macadam roads can be ripped with ease. The teeth are shaped so that they will dig into the hardest surface.

The grade-ripper performs its work in a simple, effective manner. It has a ripping width of 48 or less inches and is operated by one man who at all times sees the work. The teeth are double ended and may be sharpened or drawn.

New Hercules Road Roller

The Hercules road roller has been announced by the Hercules Company, Marion, Ohio. This roller is built of steel throughout. The weight is uniformly distributed and wheel pressures are in accordance with the specifications of the several State Highway Departments. Nearly fifty roller and ball bearings are used, insuring smooth operation. All gears and clutches operate in a bath of oil and are housed in a dust-proof cast-steel differential-transmission housing. Gears are all drop-forged with wide faces.

The Hercules roller is equipped with a six-cylinder engine with ample reserve power, assuring ease of operation on all grades. It handles as easily as the average motor car. There are three speeds in each direction, forward and back—low speed 1½ miles per hour—intermediate speed 3.2 miles per hour—high speed 5½ miles per hour. This assures fast work on all jobs of rolling and quick movement between jobs. The high travel speed and reserve power gives the roller added utility as a tractor.

The Hercules Company is associated with three widely known manufacturers of road building machinery and contractor's equipment that have a background of more than fifty years in this field.

Trackson Now Equipped With W-K-M Boom and Winch

The W-K-M boom and side winch is now being manufactured for mounting on the Model DH Trackson McCormick-Deering. This equipment, which is made by the W-K-M Co., Inc., Houston, Texas, greatly increases the versatility and usefulness of the Trackson unit, which has already proved of value in the highway, general contracting, industrial and other fields. With the W-K-M boom it is adaptable to backfilling, by the use of a throw-out bucket or Mormon board; pipe handling and laying, and other similar operations.

This combination of equipment is an ideal portable handling unit. It lifts and carries loads of 4500 pounds and will raise much heavier loads when stiff-leg is used. The traction provided by the Trackson Crawlers enable the power unit to carry the boom wherever it is needed, regardless of difficult ground conditions such as swamp land, steep grades, underbrush, loose sand or gravel, etc.

The boom may be mounted on the tractor quickly and easily in the field since the installation requires no drilling or cutting. An advantage is the fact that the boom when installed does not interfere with the use of the Trackson McCormick-Deering for drawbar operations.

The normal length of the W-K-M boom is 13½ feet; extended, its maximum length is 19 feet. The side winch has two drums, each with a capacity for 495 feet of ½-inch cable. The clutches are of the internal expanding, two-shoe friction type, 13¾ inches in diameter and each 35 inches long. All shocks and strains to the boom and side winch are absorbed by "A" frames provided at each side of the tractor, and the equipment is provided with ball and socket joints throughout to overcome strain through track oscillation.

Mormon boards, special sheaves, stiff legs, pipe hooks for various sizes of pipe and other extra equipment for this unit may also be obtained. Either the Trackson Co., Milwaukee, Wis., or the W-K-M Co., Inc., Houston, Texas, will furnish complete information on request.

Motor Trucks on Sea Wall Construction

The Malden Crushed Stone Company, Boston, a contract for placing 700 feet of false sea wall to protect concrete sea walls from erosion at Revere Beach, near Boston, used four Sterling dump trucks. The work was completed in four days. Approximately 1800 tons of blasted rock was hauled from the quarries to the wall, a distance of about ten miles round trip. The trucks averaged 112 tons each daily with about 8 tons to the load, making 14 trips per day and driving through considerable traffic congestion.

Deliveries were made directly to the beach and to the exact location where desired and which made it necessary for the trucks to pull through two feet of water at times when the tide was in. This eliminated re-handling, however, and which in itself saved considerable in labor costs. Not only were labor costs reduced, but much time as well, as the customary method for work of this character was to deliver the rock as close to the beach as possible and then rely on horse drawn boats and physical labor to place the rock.

Engineering Societies

(*Concluded from page 38*)

of Ann Arbor, Mich., has been named acting president of the Council. He will occupy the office until the return from a trip around the world of Carl E. Grunsky of San Francisco, former head of the American Society of Civil Engineers, who has been elected president for a two-year term, succeeding Arthur W. Berresford of New York.

Following are the new members of the Administrative Board, the governing body of the Council.

American Institute of Electrical Engineers—C. O. Bickelhaupt, Atlanta, Ga.; H. A. Kidder, New York City; R. F. Schuchardt, Chicago; Prof. C. F. Scott, Yale University; C. Skinner, East Pittsburgh.

American Society of Civil Engineers—H. S. Crocker, Denver, Colo.; A. J. Dyer, Nashville, Tenn.; Anson Marston, Iowa State College; Frank M. Williams, Albany, N. Y.

American Society of Mechanical Engineers—Charles Piez, Chicago; John Lyle Harrington, Kansas City, Mo.; R. C. Marshall, Jr., Chicago; E. N. Trump, Syracuse, N. Y.; John H. Lawrence, New York City; D. Robert Yarnall, Philadelphia.

American Institute of Consulting Engineers—Edwin F. Wendt, Washington.

Regional district members of the Board follow:

District No. 1, George A. Reed, Commissioner of Public Works, Montpelier, Vt., representing the Vermont Society of Engineers; District No. 2, Burritt A. Parks, Grand Rapids, Mich., Grand Rapids Engineers Club; District No. 3, J. S. Dodds, Ames, Ia., Iowa Engineering Society; District No. 4, C. B. Hawley, Washington, D. C., Washington Society of Engineers; District No. 5, A. A. Krieger, Louisville, Ky.; Engineers and Architects Club of Louisville; District No. 6, W. W. Horner, St. Louis, Mo., Engineers Club of St. Louis.

Personals

Daniel E. Morgan, a lawyer, has been appointed city manager of Cleveland, O., succeeding W. R. Hopkins, former manager.

George J. Fertig has been appointed director of research and chemical and physical laboratories of the Southern District of the Pittsburgh Testing Laboratory, with headquarters at Birmingham, Ala. Mr. Fertig was formerly chemical engineer for the Birmingham Slag Co.

George B. McGrath, general manager of the George Washington Stone Corp., Washington, D. C., died recently in Washington. He was 54 years of age.

Major Geo. C. Wright, Rochester, N. Y., county engineer of Monroe County, N. Y., has been elected president of the New York State Reserve Officers' Association.

Civil Service

Engineering Draftsman.—Applications for Principal Engineering Draftsman, $2,300 to $2,800 a year; Senior Engineering Draftsman, $2,000 to $2,500 a year; and Engineering Draftsman, $1,800 to $2,100 a year must be on file with the Civil Service Commission at Washington, D. C., not later than March 19. The examinations are to fill vacancies in the Panama Canal Service and in the Federal classified service throughout the United States. In the Panama Service the entrance salary for principal engineering draftsman is $239.58 a month, and for engineering draftsman $187.50 a month. Eligibles are not required for the senior grade in the Panama Canal Service. The optional subjects are architectural, civil (general), electrical, hydraulic, mechanical, structural, and topographic. Competitors will not be required to report for examination at any place, but will be rated on their education, experience, and fitness, and on specimens of drawing and lettering.

Information: Full information may be obtained from the United States Civil Service Commission, Washington, D. C., or from the Secretary of the United States Civil Service Board of Examiners at the post office or customhouse in any city.

COST DATA

1.5 Miles of Concrete Road

Maryland State Road Commission—Frederick and Montgomery Counties

Bids received Aug. 6, 1929.

1. L. R. Waesche & Son, Thurmont, Md.; 2. Fred D. Carozza, Baltimore, Md.; 3. M. J. Grove Lime Company, Lime Kiln, Md.; 4. Poffinberger & Mause, Myersville, Md.

QUANTITIES	(1) UNIT PRICE BID	(2) UNIT PRICE BID	(3) UNIT PRICE BID	(4) UNIT PRICE BID
"Excavation," 5,700 cu. yds.	.65	.72	.66	.70
"One Course Pl. Cement Concrete Pavement," 9"x6.3", 14,650 sq. yds.	1.64	1.69	1.72	1.97
"Class 'A' Concrete," 10 cu. yds.	18.00	18.00	18.00	18.00
"Class 'C' Concrete," 65 cu. yds.	16.00	17.00	16.00	18.00
"Deformed Steel Bars," 1,000 lbs.	.06	.10	.06	.08
18" Cast Iron Pipe, 30 lin. ft.	3.80	3.80	4.00	4.50
24" Cast Iron Pipe, 60 lin. ft.	5.00	5.00	5.00	6.00
12" Corr. Metal Pipe, 162 lin. ft.	2.00	1.75	1.90	2.00
14" Corr. Metal Pipe, 134 lin. ft.	2.25	2.00	2.00	2.00
16" Corr. Metal Pipe, 66 lin. ft.	2.50	2.40	2.25	2.50
12" Corr. Metal Pipe (Relaid), 66 lin. ft.	1.00	1.00	1.00	1.00
"Removed Masonry," 5 cu. yds.	5.00	5.00	2.50	1.00
"Drilled Holes," 35 lin. ft.	1.00	.50	1.00	1.00
TOTAL OF BIDS	$30,341.50	$31,479.90	$31,497.80	$35,638.50

Paving

Pittsburg, Kans.

Date of Contract—Stptember 4, 1929

1,619.6 sq. yds. 7-in. concrete paving, mixture 1-2-3½, crushed rock for coarse aggregate, crown of pavement 2½ in.; cost per sq. yd. $2.28
916 cu. yds. grading in light clay soil; cost per cu. yd. .... .60
1,037.4 lin. ft. 6-in.x24-in. combined curb and gutter, base mixture 1-2-2¾, finish 1-1¾; cost per ft. .... .80
Cost of labor; per day 3.20
Cost of sand delivered; per yard 3.50
Cost of crushed rock delivered; per yd. 2.40
Cost of cement delivered; per 100 lbs. .... .60
Final payment: $5,058.06.
Contractor: DuBois Construction Company.
Information furnished by: P. B. Smith, assistant city engineer. *(League of Kansas Municipalities.)*

Sidewalk

Council Grove, Kans.

Date of Contract—Sepember 3, 1929

5,500 sq. ft. one course 4-in. sidewalks; concrete on 2-in. sand base; cost per sq. ft. $0.15
Width of walk ....10 ft.
Cost of labor; per day 3.20
Cost of sand delivered 1.90
Cost of cement delivered .... .65
Total contract price: $915.50.
Contractor: C. J. McCoy, Emporia, Kansas.
Information furnished by: R. M. Armstrong, city clerk. *(League of Kansas Municipalities.)*

Paving

Oakley, Kans.

Date of Contract—October 22, 1929

4,173 sq. yds. 6-in. plain concrete paving; cost per sq. yd. $1.47
1,326 cu. yds. grading at average depth of 6 in. in clay soil; cost per cu. yd. .... .70
2,288 lin. ft. 8-in. curb and 3-ft. gutter; cost per ft. 1.02
Cost of labor; per day 4.00
Cost of sand delivered; per yd. 1.00
Cost of cement delivered; per 100 lbs. .... .85
Total contract price: $10,437.37.
Contractor: M. R. Ammerman, Wichita, Kansas.
Information furnished by: K. W. Davis, city clerk. *(League of Kansas Municipalities.)*

Paving

Eldorado, Kans.

Date of Contract—November 5, 1929

830 sq. yds. 6-in. reinforced concrete paving; mesh reinforcing 40 lbs. to 100 sq. ft.; cost per sq. yd. $2.38
112.9 cu. yds. grading at average depth of 6 in. in clay and gravel; cost per cu. yd. .... .60
695 lin. ft. 6-in.x24-in. curb and gutter; cost per ft. .... .84
Cost of labor; per day 3.20
Cost of sand delivered; per ton 1.30
Cost of crushed rock delivered; per ton 1.95
Cost of cement delivered; per 100 lbs. 2.09
Total contract price: $2,966.94.
Contractor: E. E. Kennedy, Eldorado, Kansas.
Information furnished by: F. E. Schide, city engineer. *(League of Kansas Municipalities.)*